Information from Industry on Applied Nanomaterials and their Safety

Deliverable 1

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TABLE OF CONTENTS

1. INTRODUCTION

1.1 Background to the Study

Although nanomaterials may offer high potential benefits for consumers, workers, patients and the environment, at the same time they may expose humans and the environment to new risks, possibly involving quite different mechanisms of interference with the physiology of human and environmental species.

The challenge for regulators is therefore to strike a balance between the introduction of promising new materials and the need to provide a high level of protection for health, safety and the environment.

The Commission recently concluded[1] that current EU legislation covers to a large extent risks in relation to nanomaterials and those risks can in principle be dealt with under the current legislative framework. However, current legislation may have to be modified in the light of new information becoming available, for example as regards thresholds used in chemicals legislation (such as the Regulation on Classification, Labelling and Packaging (CLP)).

1.2 Objectives of the Study

Milieu with support from Risk & Policy Analysts has been commissioned by DG Environment to advise on the need for additional data reporting on nanomaterials, the options for such reporting and to provide recommendations for an EU scheme to support the future regulation of nanomaterials.

The Technical Description for the study describes the key tasks as follows:

- **Task 1:** To analyse the European market for nanomaterials and establish:
  - which are the main substances at the nanoscale currently on the market;
  - whether and how these substances will be registered under REACH; and
  - what relevant information will not become available (from the REACH process).

- **Task 2:** To analyse the options, benefits, drawbacks and organisational (including legal) aspects of an EU wide voluntary reporting scheme that can gather the missing information identified in Task 1.

- **Task 3:** To organise a 1-day stakeholder conference to discuss the way forward.

- **Task 4:** To make a specific proposal for an effective and practical voluntary reporting system taking account of:
  - data requirements for a chemicals safety assessment;
  - the need for a scheme with an incentive structure that encourages broad involvement from all relevant sectors;

[1] EC (2008): **Regulatory Aspects of Nanomaterials**, Communication from the Commission to the European Parliament, the Council and the European Economic and Social Committee, COM (2008) 366 final dated 17.06.2008.

- existing legal obligations and the need to ensure a minimum administrative burden on companies involved; and
- the need to be open and transparent whilst respecting business confidentiality.

1.3 Approach to the Study

A kick-off meeting for this project was held with the Commission in January 2009 with progress meetings held in April and July 2009. These meetings were attended by both DG Environment (the client for this study) and DG SANCO which has a particular interest in the well-being of consumers.

1.4 Structure of the Report

The remaining sections of this report on Task 1 are organised as follows:

- Section 2 provides an overview of nanomaterials in the EU;
- Section 3 identifies the various products of interest;
- Section 4 discusses the relevance and (potential) role of REACH and CLP in collecting information on nanomaterials on the market; and
- Section 5 summarises the key findings.

Annex I to the report provides extracts of the database of nanomaterials identified on the EU market.

2. OVERVIEW OF NANOMATERIALS

2.1 Introduction

The intention for Task 1 was to develop a structured approach to characterise nanomaterials that may be present on the EU market starting from the basics. As such, this involved consideration of how nanomaterials are defined and the development of key descriptors for their source, nature and use (whether actual or potential). It was considered that this approach would provide an overview across the range of current (and near-future) applications of nanomaterials within the EU. Furthermore, it enabled a database of a range of representative applications to be developed during the course of this Task.

It is, of course, accepted that other information sources are available which, for some readers, may be more relevant (such as those sources which list products containing nanomaterials). Where appropriate, these have been identified within this report.

2.1.1 Definitions

Although the term **nanomaterial** has often been used to refer to a material with dimensions on the nanoscale (such as SCENHIR, 2007 and EFSA, 2009), recent international standards have adopted the term **nano-object** defined as follows:

- a **nano-object** may be defined as material with one, two or three external dimensions in the nanoscale; where
- **nanoscale** means the *size range from approximately 1 nm to 100 nm less* (definitions taken from ISO, 2008[2]).

ISO is also working on definitions[3] for nanostructured materials where the current mind-map proposes that these materials are determined by having *an internal or surface structure at the nanoscale* (see, for example, Pridöhl, 2009). Thus, the generic term 'nanomaterials' in ISO refers to materials covered by two specialised definitions; nano-objects and nanostructured materials. As many of the legislative challenges and potential negative environmental and health effects may be similar for both types of material, for the purpose of this report the term nanomaterials is used.

Interestingly, in relation to cosmetics, the European Parliament made an attempt to include materials with external and/or internal dimensions at the nanoscale by adopting[4] the following definition:

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[2] Although there is a general consensus amongst 'official' bodies that the nanoscale ranges up to 100 nm for the nano-objects, there are calls from non-governmental bodies for the upper limit to be extended to 300nm for manufactured nano-objects (see, for example, Vengels, 2008).

[3] ISO TS 12921: *Nanotechnologies - Terminology and Definitions for Nanostructured Materials* scheduled for publication in July 2011 (according to AFNOR, the French national standards organisation, see: http://www.afnor.org/profils/centre-d-interet/gestion-des-risques-et-sst/normes/normes-a-l-etude/(limit)/25/(page)/6)

[4] European Parliament legislative resolution of 24 March 2009 on **the proposal for a regulation of the European Parliament and of the Council on cosmetic products (recast) (COM(2008)0049)**. Resolution and recast text available form: http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+TA+P6-TA-2009-0158+0+DOC+XML+V0//EN&language=EN#BKMD-13.

- **nanomaterial** means an insoluble or bio-persistent and intentionally manufactured material with one or more external dimensions, or an internal structure, on the scale from 1 to 100 nm.

However, more generally, the European Parliament is of the view[5] that:

> *the current discussion about nanomaterials is characterised by a significant lack of knowledge and information, leading to disagreement starting at the level of definitions,* which leads it to call for:
>
> *the introduction of a comprehensive science-based definition of nanomaterials in Community legislation as part of nano-specific amendments to relevant horizontal and sectoral legislation;* and
>
> *the Commission to promote the adoption of a harmonised definition of nanomaterials at the international level and to adapt the relevant European legislative framework accordingly.*

Although there is, as yet, a lack of consensus over definitions, the Consultants (under the guidance of DG Environment) have adopted the use of the term **nanomaterial** to cover both nano-objects and nanostructured materials. In the analysis which follows, it is important to stress that reliance (to a large extent) has been placed on the claims of product manufacturers and suppliers that their products contain nanomaterials.

2.1.2 Characterisation

In order to assemble information on the current and near-future use of nanomaterials within the EU, it is necessary to provide a means by which particular applications can be readily characterised on a consistent basis.

For the purposes of this study, the following key characteristics[6] have been adopted:

- parent substance (element or compound);
- type of nanomaterials;
- categorisation of product (application); and
- state of development.

These are discussed in a little more detail in this and the next section – together with some examples.

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[5] European Parliament resolution of 24 April 2009 on **regulatory aspects of nanomaterials (2008/2208(INI))**, resolution and text available from: http://www.europarl.europa.eu/sides/ getDoc.do?type=TA&language=EN&reference=P6-TA-2009-0328.

[6] It should be noted that these 'characteristics' have been selected to provide a basis for categorising different nanomaterials. As such, these characteristics should not be regarded as the key attributes in relation to any associated hazards.

2.2 Parent Substance

Hansen (2008) found that, for a database of consumer products containing nanomaterials that were currently on the market, only six parent substances were used:

- silver;
- carbon (all allotropes);
- zinc oxide;
- silica;
- titanium dioxide; and
- gold.

Clearly, there are numerous other substances which are being developed and, in some cases, have been placed on the market. By way of example, in its work on nanomaterials, OECD (2008) provides some additional substances being used in current and near-future applications including:

- iron;
- aluminium oxide ;
- cerium oxide; and
- polystyrene.

OECD also mentions various organic compounds and minerals used to produce dendrimers[7] and nanoclays respectively.

Overall, the chemical substances in use in nanomaterials may be grouped as follows:

- **Inorganic** – examples include metals or metal oxides such as silver and iron; alkaline earth metals such as calcium and magnesium; non-metals such as selenium and silicates;
- **Organic** – examples include a number of nanomaterials developed for use in cosmetics, food/feed and medicine products, as well as nano-carrier systems containing antimicrobials, and nutritional and health supplements etc.; and
- **Surface functionalised** – that may be inorganic in nature but with surface functionalised with organic moieties, and *vice versa*. Examples include organically modified nanoclays for food packaging applications, and a variety of materials for cosmetics, drug delivery and other medical applications.

[7] Synthetic, three-dimensional macromolecule built up from a monomer, with new branches added in a step-by-step fashion until a symmetrical branched structure is created (BSI, 2005).

2.3 Type of Nanomaterial

2.3.1 Nano-Objects

As a broad generalisation, nano-objects may be produced in one, two or three dimensions. For simplicity, the following types[8] have been selected:

- 1D - one dimensional nano-objects defined as **nanoplates** which are essentially nanoscale films and surface coatings;
- 2DS and 2DH - two dimensional nano-objects defined as **nanofibres** which may be solid (**nanorods**, 2DS) or hollow (**nanotubes**, 2DH); and
- 3D - three dimensional nano-objects defined as **nanoparticles** which would include nanopowders, fullerenes (or buckyballs), quantum dots and dendrimers.

As a broad generalisation, nanoparticles are more likely to be of concern than nanoplates and nanofibres due to their potential to cross biological membranes.

2.3.2 Nano-Structured Materials (NSM)

As discussed in Section 2.1, nanomaterials are also taken to include nano-structured materials (NSM) in which the internal or surface structure is at the nanoscale.

NSM include agglomerates and aggregates which may be defined (based on EFSA, 2009) as:

- An **agglomerate** is a group of nano-objects and/or aggregates held together by weak forces, such as Van der Waals forces or electrostatic forces in which the resulting external surface area is similar to the sum of the surface areas of the individual components; and
- An **aggregate** is a group of nano-objects held together by strong forces, such as those associated with covalent or metallic bonds where the resulting external surface area may be significantly smaller than the sum of calculated surface areas of the individual components.

As a broad generalisation, agglomerates are likely to be of greater concern than aggregates not only because of their greater (and potentially more reactive) surface area but also because of their potential to release nanoparticles (SCENIHR, 2005).

The point at which a NSM (with particular reference to an aggregate) is considered to cease to be a nanomaterial is a matter of debate. In its recent opinion, SCENIHR (2009) suggests adding a surface criterion to that for a nano-scale structure:

> *However, when a nanomaterial is in particulate form, the particles may be present as single particles but might also be present as agglomerates/aggregates. Depending on the nanomaterial, the majority of the particulates may actually be agglomerates/aggregates. This may lead to the misinterpretation that agglomerates/aggregates of nanoparticles that have dimensions well beyond the 100 nm size are not considered nanomaterials. Yet they retain specific physicochemical properties which are characteristic for nanomaterials, most likely due to their relative large specific surface area (SSA). ….. Hence, extending the current definition based on physical size by the addition of a limit of the specific*

[8] Adoption of these types is essentially the same as those defined by ISO (2008).

surface area to be above 60 m²/g of material volume (the value of 60 m²/g corresponds to the specific surface area of 100nm solid spheres of unit density) should be considered.

Although such distinctions are possible, there is currently great uncertainty as to the precise distribution of 'free' and 'bound' nanoparticles as illustrated by the SCENHIR (2009) opinion:

The uncertainty regarding the presence of nanomaterials (either determined by size, <100 nm, or SSA >60 m^2/g when calculated for <100 nm unit density spheres) in products becomes of major importance when the only information on the presence of a nanomaterial relies solely on the information provided by the manufacturer. Currently, it is frequently not possible to evaluate the nanomaterial contents of these products when the nanomaterial in question is mixed into a complex matrix of the finished product. This unresolved issue occurs in consumer products, particularly cosmetics and health care products, and also in food and feed products.

With these points in mind, the 'type of nanomaterial' used to characterise nanomaterials on the market has, in the first instance, been taken as the primary nano-object which may (or may not) have been incorporated into a nano-structured material (NSM). Although there are uncertainties, an indication is also provided as to whether the nano-objects are likely to be present in the form of a NSM within the product. It is, of course, acknowledged that in the future such categorisation could be revised to indicate whether the nanomaterial is, in fact, a NSM – for example, with reference to a specific surface area above a certain prescribed limit.

2.4 Categorisation of Product

Nanomaterials are used in a diverse range of products. There are various means by which such products can be classified. Hansen *et al* (2008) have suggested categorising products containing nanomaterials into 11 categories. Given the relevance of REACH (discussed further in Section 4), another possibility would be to use the 40 Product Categories listed in the ECHA Guidance relating to exposure assessments (ECHA, 2008a).

However, after reviewing such approaches, it is difficult to determine any benefits of such systems over the 'standard' EU classification system which has 22 categories for manufactured products – as considered in more detail in Section 3.

2.5 State of Development

In relation to the state of development of particular products containing nanomaterials, it is possible to provide three possible states:

- Current – the product is currently on the EU market;
- Near-future – the product has undergone research and is currently being developed for placement on the EU market; and
- Research – the product (or application) is subject to research.

2.6 Data Collection and Collation

The next step was to assemble data on nanomaterials within the EU into the categories as outlined above. The data collection was primarily based on desk-based research using published studies, web-based resources, product/company information and (trade) news items. As such, considerable reliance was placed on the claims of manufacturers and suppliers and no attempt was made to verify the claims made. Similarly, where nanomaterials are used but are not announced then such uses would not be identified.

In practical terms, various team members (and additional RPA researchers) were assigned a few product groups (from the list of 22 different categories) with the intention of identifying the use of nanomaterials within those categories. The focus was on those nanomaterials which may be described as 'current' or 'near-future' rather than listing the numerous and extremely diverse range of nanomaterials referred to in research papers and in patents. Furthermore, the emphasis was on identifying a range of uses (including, in some cases, examples of 'research') rather than listing each and every product using the more common nanomaterials.

With these points in mind, the examples presented in Annex I should not be seen as definitive list of nanomaterials in current or near-future use within the EU. Rather, the examples provide an indication of the range of nanomaterials in use and the range of applications/products in which nanomaterials may be found.

Some of the sources identified which list large numbers of specific products containing nanomaterials include:

- Perhaps the most comprehensive on-line resource (for nanomaterials in consumer articles) is the **Project on Emerging Nanotechnologies** (based on a partnership between the Woodrow Wilson International Center for Scholars and the Pew Charitable Trusts). There are several on-line data-bases (http://www.nanotechproject.org/inventories/) including the '*inventory of nanotechnology-based consumer products currently on the market*' which lists 800 consumer products and is widely used in other publications (such as Afsset (2006));
- The current availability of nanomaterials is clearly demonstrated through the searchable *Nanomaterials Database* from Nanowerk. This on-line resource provides links to over 2,000 commercially available nanomaterials (from nearly 150 suppliers) (http://www.nanowerk.com/phpscripts/n_dbsearch.php);
- Another extensive on-line resource including directories not only by material but also by suppliers, applications and industry is *A to Z of Nanotechnology*. The material directory (http://www.azonano.com/materials.asp) lists over 1300 nanomaterials;
- The US EPA's Nanoscale Materials Stewardship Program has led to 29 companies and trade associations submitting information (often limited and/or confidential) on 123 nanomaterials (based on 58 chemicals) of which less than half are 'commercial' (http://www.epa.gov/opptintr/nano/stewardship.htm)
- Although not as extensive, an overview from the *Oklahoma Nanotech Initiative* of the range of products (*http://www.oknano.com/pdf/NanoProducts*Showroom.pdf) available to the ordinary US consumer is instructive; and
- A recent (June 09) listing of 100 consumer products has been presented by the European consumer bodies (ANEC/BEUC) in their position paper *Nanotechnology: Small is beautiful but is it safe?* (http://www.anec.org/attachments/ANEC-PT-2009-Nano-002final.pdf)

Other more general reference sources identified include:

- Within the EU, *ObservatoryNANO* is a major collaborative project (funded for four years under FP7) which commenced work in 2008. Initial reports on the current trends (by sector) of the applications of nanotechnology are available (via http://www.observatorynano.eu/project/catalogue/2/); and
- The Institute of NanoTechnology (http://www.nano.org.uk) provides another useful resource for current developments (both commercial and academic).

The collected data were entered onto a data-base with fields exportable into a simple summary spreadsheet.

3. PRODUCTS OF INTEREST

3.1 Overview of Nanomaterials in Use

With reference to the more common types of nanomaterials in use, Table 3.1 summarises the main applications of nanomaterials by parent substance.

Table 3.1: Main Application Areas for Nanomaterials by Parent Substance

Parent	Main Application Areas
Silver	Nano-silver is currently the most commonly used nano-object in a wide range of consumer products. An increasing number of nano-silver containing products is available, including cosmetics and personal care products, food and health-food, antimicrobial paints and coatings, hygienic surfaces and packaging materials, and medical applications etc.
Carbon black	Carbon black is produced at industrial scale in high tonnage volumes, and has applications in tyre manufacturing.
Fullerenes and carbon nanotubes	Carbon nanotubes (CNT) are elongated tubular structures, typically 1-2 nm in diameter and perhaps more than 1 mm in length. CNTs can be formed as single-wall carbon nanotubes (SWCNTs) or multi-wall carbon nanotubes (MWCNTs). CNTs have very high tensile strength and exhibit high conductivity, high surface area, distinct electronic properties, and potentially high molecular adsorption capacity. Because of the high tensile strength, the main use of CNTs is in structural materials, such as ceramic and polymer composites, conducting composites for the aerospace, automotive and electronics industries, and in adhesives such as epoxy resin. A major area of CNT application is in the electronics sector. CNTs are already produced in multi-tonne volumes, and the production is likely to increase in the future. For example, Bayer Material Science has opened a new CNT production facility in 2007, doubling their production to 60 tonnes per year. They also have plans to open new plants to take production to up to 300 tonne/year. Other EU producers include Nanocyl (Belgium), Arkema (France) and Thomas Swan & Co (UK).
Fumed (amorphous) silica	Fumed amorphous silica is produced in high tonnage volumes, and used for a variety of applications. These include paints and coatings, polishing microelectronic devices, food contact surfaces and food packaging applications. Advantages of nanosilica based paints and coatings include a reduction in the amount of materials and solvents, extended life of paints and coatings that reduces the frequency of re-coating. For example, scratch resistance of coatings can also be improved dramatically by adding ~15% of nano-silica. Porous silica is also used in nano-filtration of water and beverages. Amorphous silica is believed to be used food applications, such as in clearing of beers and wines, and as a free flowing agent in powdered soups (and in condiments, qv).
Titanium dioxide	Nano-titanium dioxide is produced in high tonnage volumes for main uses in paints and coatings (as a UV absorber to help prevent UV degradation), cosmetics (in sunscreens to prevent UV damage to skin), and packaging applications.
Zinc oxide	Zinc oxide is currently produced in small but growing tonnage volumes. It is mainly used in cosmetics and personal care products, but other applications such as antimicrobial packaging, are have also emerged recently.
Nanoclays	Nanoclays are used for a variety of applications. The nanoclay mineral most commonly used is montmorillonite (also termed as bentonite), which is a natural clay obtained from volcanic ash/rocks. Nanoclays have a natural nano-scaled layer structure and are often organically modified to bind to polymer matrices to develop improved materials, such as composites with enhanced gas-barrier properties for food packaging.
Cerium oxide	Nano-sized cerium oxide is used as a secondary fuel catalyst in diesel. The application is claimed to reduce fuel consumption and particulate emissions. Typically added to diesel at a concentration of 5-10 ppm, nano-cerium oxide is claimed to increase fuel efficiency by ~10%. The catalyst is already in use on a large scale in bus fleets in a number of countries including the UK, Philippines and New Zealand.

Table 3.1: Main Application Areas for Nanomaterials by Parent Substance	
Parent	**Main Application Areas**
Iron	Zero-valent nano-iron is finding an increasing use in water treatment and for the remediation of contaminated soils. Nano-iron is used in the treatment of contaminated waters, e.g. groundwater, where it is claimed to decontaminate water by breaking down organic pollutants and killing microbial pathogens.
Organics	A wide range of organic nanomaterials is available for uses mainly in cosmetics, food and medicine sectors. Examples of the available nanomaterials include vitamins, antioxidants, colours, flavours, preservatives, active ingredients for cosmetics and therapeutics, detergents etc. The main tenet behind the development of nano-sized organic substances is the greater uptake, absorption and bioavailability of bioactive substances in the body, compared to conventional bulk equivalents. This category of nanomaterials also includes nano-carrier based delivery systems for drugs, cosmetics, nutrients and supplements. These are based on nano-encapsulation of the substances in liposomes, micelles, or other biopolymers. Whilst the concept of nano-carrier systems originated in relation to improved or targeted drug delivery, they are finding increasing applications in the cosmetics and food sectors.
Other	Other nanomaterials that are produced at an increasing commercial scale include metal and metal oxides of aluminium, copper, tin, zirconium, metal nitrides (e.g. titanium nitride), alkaline earth metals (calcium, magnesium), non-metals (selenium). Quantum dots – composed of metal (oxide), or semiconductor materials with novel electronic, optical, magnetic and catalytic properties are also finding increasing applications in medical imaging and diagnostics and security printing. The production of quantum dots, however, may not be high-tonnage at present.
Source: Based on Aitken et al (2008)	

3.2 Classification of Uses

Within the EU, there are numerous systems in use for the classification of trade, products and activities. For the purposes of this study, use has been made of the *Statistical Classification of Products by Activity in the European Economic Community, 2008 Version* (Eurostat, 2008), hereafter referred to as CPA 2008[9].

Under CPA 2008, products are grouped at several levels as illustrated below using the example of socks (which may contain nano-silver):

C Manufactured Products
14 Wearing apparel
14.3 Knitted and crocheted apparel
14.31 Knitted and crocheted hosiery
14.31.1 Panty hose, tights, stockings, **socks** and other hosiery, knitted or crocheted
14.31.10 Panty hose, tights, stockings, **socks** and other hosiery, knitted or crocheted

[9] While the CPA classification is based on 'products by activity', there is another similar classification of 'economic activities' (NACE). Where classifications overlap, the CPA 2008 and the NACE (Revision 2) codes are now the same. Similarly, the product codes as listed in PRODCOM 2009 are (essentially) the same as those in CPA 2008. Hence the 14.31.10 code under PRODCOM 2009 is *Panty hose, tights, stockings, socks and other hosiery, knitted or crocheted* which is the same as for CPA 2008. In short, CPA 2008, NACE (Revision 2) and PRODCOM 2009 (products) form an integrated EU classification system (see circa.europa.eu/irc/dsis/nacecpacon/info/data/en/index.htm).

CPA 2008 has been used to provide a framework for presenting the identified uses of nanomaterials and a summary of the main categories is presented in Table 3.2.

Table 3.2: Outline Codes from CPA 2008 Classification		
C	MANUFACTURED PRODUCTS	
	10	Food products
	11	Beverages
	12	Tobacco products
	13	Textiles
	14	Wearing apparel
	15	Leather and related products
	16	Wood and of products of wood and cork, except furniture; articles of straw and plaiting materials
	17	Paper and paper products
	18	Printing and recording services
	19	Coke and refined petroleum products
	20	Chemicals and chemical products
	21	Basic pharmaceutical products and pharmaceutical preparations
	22	Rubber and plastics products
	23	Other non-metallic mineral products
	24	Basic metals
	25	Fabricated metal products, except machinery and equipment
	26	Computer, electronic and optical products
	27	Electrical equipment
	28	Machinery and equipment n.e.c.
	29	Motor vehicles, trailers and semi-trailers
	30	Other transport equipment
	31	Furniture
	32	Other manufactured goods

To ensure that CPA 2008 references are not confused with references to other sections of the report, the initial letter C from the CPA Code has been included. So, for example, C14.31 refers to the CPA 2008 classification for: *Knitted and crocheted hosiery*.

3.3 Nanomaterials by Product Group

71 examples of the use of nanomaterials were entered on to a data-base and are presented in Annex I. As already noted, the prime intention of these examples is to provide an indication of the range of nanomaterials in use and the range of applications/products in which nanomaterials may be found.

The data-base contains examples of 39 products currently on the EU market, 10 products which are likely to come to the EU market in the near future[10] and 22 applications which are still in the research phase.

Half of the examples chosen refer to the more commonly found substances (carbon, silver, gold, zinc oxide, silica, titanium dioxide). This, in part, reflects the greater focus on the less common parent substances found in the other examples.

Although nanomaterials may be used across a wide range of applications and products, it was found that use of the CPA Code tended to focus the examples on fewer product groups than might have been expected – as outlined further below.

3.3.1 Food products C10

The current use of nanomaterials within EU food products is limited but is likely to grow (EFSA, 2009; TA-Swiss, 2009). However, several examples are presented in Annex I.

As can be seen from these, most involve nanomaterials derived from less common parent substances although nano-silica is used to improve the flow of condiments and spices.

3.3.2 Beverages C11

Beverages containing nanomaterials have not been identified and so no examples are presented in Annex I. However, nanotechnology may be used in the associated processing with particular reference to coatings on process pipework[11] and packaging[12]. Such coatings will be categorised under chemical products (C20).

3.3.3 Tobacco products C12

Nanomaterials do not appear to be used in tobacco products (and no examples are presented in Annex I), although there are some references to Chinese research into the use of carbon nanotubes in cigarette filters.

3.3.4 Textiles C13 & Wearing apparel C14

Four (representative) examples are presented in Annex I. Nano-silver is widely used to provide an anti-microbial function in textiles and clothing (especially socks). Other nanomaterials in use (and under development) include carbon nanofibres, nano-composites and nano-gold. The functionality of the nanomaterials in textiles ranges from physical protection in clothing to colour fastness[13].

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[10] Such 'near-future' products include products which are currently undergoing commercial development or are already on other non-EU markets.

[11] Such as used in a brewery (http://www.azonano.com/news.asp?newsID=4345)

[12] As used on plastic beer bottles (http://www.nanotechproject.org/inventories/consumer/browse/products/beer_bottle_plastics/) and (http://www.ptonline.com/articles/200508fa1.html).

[13] The range of applications is illustrated by the papers presented at the **Innovations in Textiles 2009** conference held in London, March 2009 (http://www.nano.org.uk/conferences/textiles2009/prog.htm).

3.3.5 Leather and related products C15

Nanomaterials are not generally found in leather and leather products (and no examples are presented in Annex I) – although additional protective coatings may be applied.

3.3.6 Wood and of products of wood and cork, except furniture; articles of straw and plaiting materials C16

Although no examples are presented in Annex I, several opportunities for the application of nanotechnology to wood products have been identified and associated research has been supported through the *NANOFOREST* projects funded through the 6th Framework Programme (STC, 2005). Particular attention was given to improving protective coatings and improved processing efficiencies.

3.3.7 Paper and paper products C17, Printing and recording services C18

Although some paper and printing products contain nanomaterials, particular products such as photocopier toners, inks, etc. are classified under chemical products (C20). One interesting example is presented in Annex I of ongoing research into filter papers with nanowires which may be used to clean up oil from water.

3.3.8 Coke and refined petroleum products C19

Although some petroleum products contain nanomaterials, particular products such as catalysts and additives are classified under chemical products (C20).

3.3.9 Chemicals and chemical products C20

18 nano-products appear under this product classification since this covers not only personal care products but also additives and coatings. Some of the less common substances identified in current (and near-future) products include calcium peroxide (toothpaste), cerium oxide (fuel additive), alumina (water repellent coating for wood), polyethylene terephthalate (PET as a coating on windows, etc.), polyesters (toner), ruthenium (catalyst) and tungsten disulphide (lubricant).

3.3.10 Basic pharmaceutical products and pharmaceutical preparations C21

Five examples are presented in Annex I. Nano silver is used as an antimicrobial agent in dressings and implants and, surprisingly, as a spermicide. More generally, nanotechnology is being developed to assist with drug delivery systems with many new nano-products being explored.

3.3.11 Rubber and plastics products C22

The main nanomaterial found in this product category is carbon black which is used in vehicle tyres and a generic example is included in Annex I,. However, there are moves towards the replacement of carbon black with nano-silica to produce 'green' tyres[14]. Although some other

[14] Examples include the Yokohama S.drive and the Nokian Z G2 tyres. Of note is that nano-silica will be produced in Iran (http://www.iran-daily.com/1387/3203/html/science.htm)

rubber/plastic products contain nanomaterials, particular products such as catalysts and additives are classified under chemical products (C20).

3.3.12 Other non-metallic mineral products C23

Nanomaterials are being added to non-metallic mineral products such as nano-composites and ceramic tiles to provide additional performance characteristics and two representative examples are presented in Annex I.

3.3.13 Basic metals C24

Two examples are presented in Annex I. As already mentioned, nano-iron is being used for water treatment and groundwater remediation. The other identified use is that of nanospheres of phosphorous which are added to copper alloy for use in brazing.

3.3.14 Fabricated metal products, except machinery and equipment C25

Nanotechnology is being applied to the development of military hardware and other products with a particular focus on those applications which require high strength/low weight ratio. Six examples (mainly research) are presented in Annex I.

3.3.15 Computer, electronic and optical products C26, Electrical equipment C27

Eight examples (mainly research) are included in Annex I. Nanotechnology is key to the development of computers, etc. and, as such, nano-products are found in electrical and electronic equipment. One of the key areas for development is likely to be new compact energy sources such as lithium-ion batteries.

Another area of current application is the use of nano-silver coating in domestic appliances (C27.5) to limit bacterial growth[15].

3.3.16 Machinery and equipment n.e.c. C28

Three examples of research are provided in Annex I which illustrate that nanotechnology is being applied to the manufacture of engines, compressors, turbines, etc. through, for example, improvements in material strength and performance.

3.3.17 Motor vehicles, trailers and semi-trailers C29, Other transport equipment C30

Nanotechnology is being used to provide additional material performance within the transport sector and 13 examples are provided in Annex I. According to *ObservatoryNANO*, there is a particular interest[16] in the development of nano-composites based on nanoclays.

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15 Many references may be found to Samsung products such as http://www.washingmachinereviews.org.uk/articles/samsungs-silver-nano-technology/

16 http://www.observatorynano.eu/project/catalogue/2TR.NC/,

3.3.18 Furniture C31

As with other product groups, although nanomaterials are not widely used in furniture (and just one research example is provided in Annex I), they may applied in protective coatings.

3.3.19 Other manufactured goods C32

Nanomaterials are used in various medical/dental applications which classified under C32. Finally, a range of 'nano wellness cards' (the size of credit cards) are being marketed[17] to bring the benefits of nanotechnology to consumers. These include 'relaxation cards' (which emit infrared), 'fridge refresh cards' (which remove odours) and 'life style cards' (which remove harmful substances from drinks).

[17] by Equation Nanotech (Beijing) (http://www.allproducts.com/manufacture97/tony8290/product5.html)

4. REACH, CLP AND NANOMATERIALS

4.1 REACH and CLP Regulations

The Regulation concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) entered into force on 1 June 2007[18] and the Regulation on Classification, Labelling and Packaging (CLP) on 20 January 2009[19].

REACH deals with substances and is based on the principle that manufactures, importers and downstream users - independently of the volumes of substances put on the market - must ensure that they manufacture, place on the market or use such substances that do not adversely affect human health or the environment.

REACH also requires that suppliers will communicate the hazardous properties and the respective classification, handling requirements, etc. to downstream users in the Safety Data Sheets. In turn, CLP Article 9(5) requires:

> *When evaluating the available information for the purposes of classification, the manufacturers, importers and downstream users shall consider the forms or physical states in which the substance or mixture is placed on the market and in which it can reasonably be expected to be used.*

In relation to registration, REACH Article 5 states that:

> *substances on their own, in preparations or in articles shall not be manufactured in the Community or placed on the market unless they have been registered in accordance with the relevant provisions of this Title where this is required*.

Furthermore Article 6 requires that:

> *any manufacturer or importer of a substance, either on its own or in one or more preparation(s), in quantities of one tonne or more per year shall submit a registration to the Agency*.

This immediately provides four possible scenarios for nanomaterials[20]:

1) If the nanomaterial is considered to be the same substance as the bulk form of the same chemical element or compound, then registration of the substance would include the nano-form and its uses. Where a registrant subsequently introduces a different nano-form of the substance to the market, the registration dossier would have to be updated.

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[18] Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) etc., (OJ L396, 30/12/06, p1).

[19] Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on Classification, Labelling and Packaging of Substances and Mixtures, etc. (OJ L353, 31/12/08, p1).

[20] Within this discussion, both the dimensions and associated properties are of relevance. As such, use has been made of the term *nanomaterials* rather than *nano-objects* (which is limited to consideration of physical dimensions).

However, the substance would be exempt from registration if the total quantity involved was less than one tonne per year. Nevertheless, all the other REACH and CLP provisions will apply to the substance as well as to its nano-forms;

2) If the nanomaterial is considered to be a distinct substance from the bulk form of the same chemical element or compound, then the nanomaterial would be exempted from the registration if the quantities involved were less than one tonne per year. However, all the other REACH and CLP provisions would apply to the nanomaterial;

3) If the nanomaterial is considered to be a distinct substance from the bulk form of the same chemical element or compound and the quantities involved were greater than one tonne per year, then registration of the nanomaterial would be required; and

4) Some substances (such as polymers) are exempt from REACH and, as such, polymers (and other exempt substances) in nano-form would not require registration in any event. However, even in such cases the CLP provisions would apply.

It is important to stress that no distinction between bulk and nano form is made within the REACH and CLP Regulations (as amended). Indeed, the pre-fix *nano* does not appear in in the CLP regulation and appears just once in the REACH Regulation – as discussed below.

Annex IV to REACH contains a list of substances exempt from registration as sufficient information is known about these substances that they are considered to cause minimum risk because of their intrinsic properties (Article 2(7)b). A further set of exempt substances are covered by Annex V, for which registration is deemed inappropriate or unnecessary.

Initially, Annex IV included carbon and graphite but these were removed under Regulation No 987/2008[21]. This revision was "*due to the fact that the concerned Einecs and/or CAS numbers are used to identify forms of carbon or graphite at the nano-scale which do not meet the criteria for inclusion in this Annex*". This would imply that nano and bulk forms of the same chemical element may be considered to be the same substance under REACH – even though the properties are quite different.

4.2 ECHA Guidance

The ECHA (2007) Technical Guidance Document (TGD) on substance identification states that "*The current state of development is not mature enough to include guidance on the identification of substances in the nanoform in this TGD"*. The guidance also draws attention to the fact that nanomaterials are nowhere defined under REACH.

Two further references to nanomaterials have been located in ECHA Guidance. In relation to chemical safety assessments, ECHA (2008) advises that risk assessors should consider exposure to nanoparticles (<100 nm) where applicable.

Similarly, in its FAQ (ECHA, 2009), ECHA states that the health and environmental properties of nanomaterials must be assessed as for any other substance in REACH. However it is

[21] Commission Regulation (EC) No 987/2008 of 8 October 2008 amending Regulation (EC) No 1907/2006 of the European Parliament and of the Council on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) as regards Annexes IV and V (OJ L 268, 09/10/08, p14).

recognised "*that the evolving science of nanotechnology may necessitate further requirements in the future to reflect the particular properties of nano particles*".

4.3 REACH Competent Authorities (CAs)

4.3.1 Status of Nanomaterials

At a meeting in December 2008, the REACH Competent Authorities[22] endorsed a paper (EC, 2008) prepared by its sub-group on nanomaterials (CASG-Nano) which concluded that nano-forms of existing substances (i.e. those with an EINECS number) would, by default, be treated as phase-in substances.

Conversely, substances in nanoform which are not in EINECS would be regarded as new substances. If such new substances were not notified in accordance with NONS or were not considered as 'no-longer polymers', they would be 'non-phase-in' substances[23] (and, as such, would not be assigned an EC Number[24]).

It is of note that while the sub-group appeared to support the view that allotropes (structurally different elemental forms) should be considered as different substances, the REACH CAs remained undecided (EC, 2009).

4.3.2 Evaluation

There are two types of evaluation of substance registrations under REACH:

- ***dossier evaluation*** that is undertaken by ECHA to examine testing proposals and to ensure that a registration dossier meets the requirements of REACH. ECHA may request additional information where needed; and
- ***substance evaluation*** that is undertaken by a CA when it suspects that a substance represents a risk to human health or the environment. Following a CA evaluation ECHA may request any further information that may go beyond the standard information requirements.

Although this suggests that ECHA could request (further) nano-specific information, the CASG-Nano state that the existence of properties specific to substances at the nanoscale and the fact that "*standard tests may not be sufficient or appropriate*" may make the substance evaluation of nanomaterials particularly problematic. CASG-Nano therefore suggest that ECHA prioritise a small number of nanomaterials for both dossier and substance evaluation (EC, 2008).

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22 As of March 2009 the group became: Competent Authorities for REACH and CLP (CARACAL). CARACAL is composed of representatives of Member States competent authorities for REACH and CLP, representatives from competent authorities of EEA-EFTA countries as well as a number of observers from non-EU countries, international organisations and stakeholders

23 Since June 2008, 'non-phase-in' substances which are manufactured (in the EU) or imported (into the EU) in quantities of more than one tonne per year need to be registered.

24 Further detail on the EC Number (i.e. the EINECS, ELINCS (NONS) or NLP number) is provided in the ECHA Guidance on substance identification (ECHA, 2007).

4.3.3 Other Provisions

Substances of very high concern (SVHCs) may be subject to the authorisation provisions of REACH which would apply to nanomaterials in the same way as for other substances.

Similarly, the requirements for Safety Data Sheets and communication in the supply chain would apply to nanomaterials as for other substances. However, it should be noted that the parameters defining information to be communicated in Safety Data Sheets and in the supply chain have not been developed with the specific properties (such as specific surface area) of nanomaterials in mind.

4.3.4 Issues Raised

The CAs anticipated particular concerns with the assessment of nanomaterials supplied in small quantities to the market. It was believed that many nanomaterials may be manufactured/ imported below the one tonne per annum threshold and the Commission agreed to encourage their voluntary registration. The Commission (van der Zandt, 2009) also agreed to encourage the early registration of low tonnage phase-in nanomaterials (supplied above the one tonne threshold) to allow for their assessment ahead of their 2018 registration deadline.

4.4 REACH Registration

4.4.1 Registration Deadlines

The registration deadlines under REACH (ECHA, 2009) are summarised in Table 4.1.

Table 4.1: REACH Registration Deadlines

Deadline	Registration Requirement
1 December 2008	Pre-registration of phase-in substances
30 November 2010	Deadline for the registration of all phase-in substances manufactured or imported above 1,000 tonnes per year* as well as CMR (Cat 1 or 2**) substances above 1 tonne per year or substances classified as very toxic to aquatic organisms (R50-R53**) above 100 tonnes per year
31 May 2013	Deadline for the registration of all phase in substances manufactured or imported above 100 tonnes per year
31 May 2018	Deadline for the registration of all phase-in substances above 1 tonne per year

Notes:

* *Quantities are per EU/EEA manufacturer and/or importer to the EU/EEA*

** *The classification referred to here is that of the current system (under the framework of Directive 67/548/EEC) which will be superseded, in stages, by CLP.*

4.4.2 Pre-registration of Parent Substances

The more common parent substances (silver, carbon, zinc oxide, silica, titanium dioxide and gold) found in nanomaterials have all been pre-registered under REACH with planned registrations in 2010[25]. As would be expected, this suggests that all six substances are manufactured and/or imported in quantities exceeding 1,000 tonnes per year in the EU.

Amongst those substances which are less commonly found in nanomaterials, there are many high volume substances for which registration is planned for 2010 (such as aluminium, calcium peroxide, tungsten disulphide). Indeed, in most of the examples listed in Annex I, where the parent substance is not exempt from REACH, the pre-registration information from ECHA[26] suggests that the registration is planned for 2010 (i.e, the substance is manufactured/imported above the 1,000 tonnes per year threshold) – although whether this occurs in practice remains to be seen.

As indicated above (Section 4.1), polymers are exempt from REACH and, as such, the corresponding substances (such as polyesters and PET) in nano-form would be exempt.

Consideration was given to some of the more 'exotic' binary nano-substances (as listed on the *Nanomaterials Database* from Nanowerk) such as praseodymium oxide, erbium oxide and gallium antimonide – but all such compounds had been pre-registered (many with a 2010 registration deadline). Although many of the more complex compounds (such as strontium titanium oxide) had been pre-registered, some (such as samarium cerium oxide) had not.

4.4.3 Pre-registration of Nanomaterials

Inspection of the substances pre-registered with ECHA reveals five specific entries for substances which are described specifically as nanomaterials (with specific reference to the inclusion of *nano* in either the substance name or synonym). These are listed in Table 4.2.

Table 4.2: Pre-Registration of Nanomaterials

Nanomaterial	EC Number	CAS Number	Registration Date (implied quantity)	Comment
Nanosilver	Not given	Not given	2018 (<100 t/yr)	Pre-registration not required (as bulk form pre-registered)
Carbon Nanotubes 1. Unspecified 2. Single-walled 3. Multi-walled	Not given	1. 308068-56-6 2. Not given 3. Not given	2018 (<100 t/yr)	May constitute a 'non-phase-in' substance[27] and as such cannot be manufactured/imported in quantities of more than one tonne/yr
A Phthalocyanine–Fullerene compound	Not given	153498-70-5	2018 (<100 t/yr)	

[25] As discussed further in Section 4.7, some forms of carbon and silicon have already been registered.

[26] List of pre-registered substances: http://apps.echa.europa.eu/preregistered/pre-registered-sub.aspx.

[27] A substance without an EC number cannot be considered a "phase-in" substance and shall be regarded as a new substance.

4.4.4 Summary

Although nanomaterials may be produced from many different substances, many of the parent substances are covered by REACH and, as such, have been pre-registered. Perhaps surprisingly, where substances have been pre-registered, the envisaged registration deadline is usually 2010 (suggesting a production/import quantity above the 1,000 tonnes per year threshold).

In other words, there would appear to be relatively few cases where the production/import quantities of the parent substances fall into the low tonnage band (i.e. less than 100 tonnes per year).

As such, the issue appears to be whether the parent substance will or will not be registered (rather than when the parent substance will be registered). There appear to be two main groups of nanomaterials which will not be covered by REACH registration:

- those based on polymers (such as polyesters and PET) and biopolymers (such as micelles); and
- those manufactured/imported in very low volumes (less than the one tonne per year threshold) including, perhaps, some complex metal1-metal2-oxides which have not been pre-registered.

Clearly, the analysis presented above has been based, to some extent, on the claimed presence (or near-presence) of nanomaterials on the EU market. As such, there are uncertainties (as indicated by SCENIHR for example) as to the precise form in which such nanomaterials are present on the EU market and, indeed, whether there are other significant groups of nanomaterials on (or near to) the EU market which have not been identified in this report (or elsewhere).

4.5 REACH Information Requirements

4.5.1 Overview

The information requirements under REACH are complex but the ECHA guidance (ECHA, 2008b) provides the following simplified overview (see Figure 4.1 - opposite) in relation to the **chemical safety assessment (CSA)** which draws upon both the substance properties (through a **hazard assessment (HA)**) and the associated **exposure assessment (EA)**.

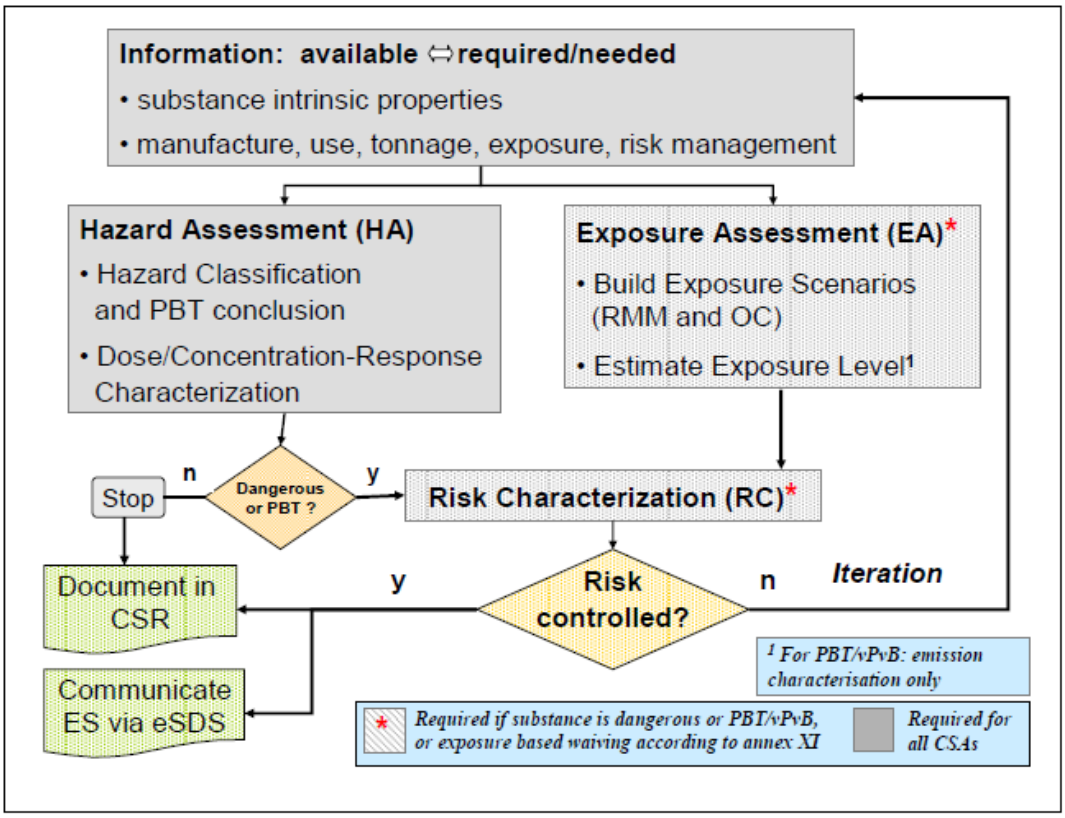

Figure 4.1: An Overview of the CSA Process (taken from ECHA, 2008b)

The requirement for the preparation of a Chemical Safety Report (CSR) applies to substances which are manufactured and/or imported above the 10 tonnes per year threshold. A manufacturer or an importer must communicate the Exposure Scenario (ES) and instructions on safe use for all substances manufactured or imported in quantities greater than one tonne per year, via an extended Safety Data Sheet (eSDS).

The requirements for the Hazard Assessment (HA) and Exposure Assessment (EA) are outlined in a little more detail below.

4.5.2 Hazard Assessment (HA)

The main information requirements for the Hazard Assessment (HA) are set out in Annexes VII to X to REACH, where the level of information required increases depending upon the quantity manufactured or imported:

- 1 tonne per year or more (Annex VII);
- 10 tonnes or more per year (Annex VIII);
- 100 tonnes or more per year (Annex IX); and
- 1,000 tonnes or more per year (Annex X).

The information requirements for a HA are summarised in Table 4.3.

Table 4.3. HA Information Requirements, Tonnage Thresholds and Relevant Annexes				
Tonnage Threshold (tonnes per year):	**1**	**10**	**100**	**1,000**
Relevant REACH Annex:	**VII**	**VIII**	**IX**	**X**
Physicochemical Properties :				
State of substance; melting/freezing point; boiling point; relative density; vapour pressure; surface tension; water solubility; partition coefficient; flash point; flammability; explosive properties; self-ignition temperature; oxidising properties; granulometry (solids only)	x	x	x	x
Stability in organic solvents and identity of relevant degradation products; dissociation constant; viscosity			x	x
Toxicological Information:				
Skin irritation/corrosion and eye irritation	x	xx	xx	xx
Skin sensitisation	x	x	x	x
Mutagenicity	x	x	x	xx
Acute toxicity	x	xx	xx	xx
Repeated dose and reproductive toxicity		x	xx	xxx
Toxicokinetics		x	x	x
Carcinogenicity				x
Ecotoxicological Information:				
Aquatic toxicity	x	xx	xxx	xxx
Degradation	x	xx	xxx	xxxx
Fate and behaviour in the environment		x	xx	xxx
Effects on terrestrial organisms			x	xx
Long-term toxicity to sediment organisms				x
Long-term or reproductive toxicity to birds				x
Note: For some properties the information requirements increase with usage (i.e. tonnage). As such, 'xxx' represents more detailed requirements than 'xx' for the same property at a lower tonnage band.				

By inspection of Table 4.3, it can be seen that the extent of information requirements for the HA and the associated level of detail increase with increased manufacture/import. In other words, the level of detail in the various requirements progressively increases as one moves from Annex VII (with a 1 tonne/year threshold) to Annex X (with a 1,000 tonne/year threshold).

4.5.3 Exposure Assessment (EA)

If the HA indicates that the substance is or should be classified as dangerous under the Dangerous Substances Directive (DSD[28]) or is a PBT/vPvB substance then the CSA must include an Exposure Assessment (EA). Reference to the dangerous substances and the DSD will steadily be superseded by reference to specific classification under the Classification, Labelling and Packaging Regulation (CLP[29]).

[28] Council Directive 67/548/EEC of 27 June 1967 on the approximation of laws, regulations and administrative provisions relating to the classification, packaging and labelling of dangerous substances, (OJ 196, 16.8.1967, p 1).

[29] Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006, (OJ L 353, 31.12.2008, p1).

The EA should contain information detailing:

- all uses throughout its lifecycle including details of possible users, e.g. formulation (industrial only), transmission, filling (industrial, professional and consumer) and disposal (industrial, professional and consumer);
- risk management measures (current, proposed and possible); and
- exposure data for all uses and users.

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There are, of course, a number of exemptions[30] to these requirements including when the specific use of the substance is already regulated under more specific legislation (e.g. biocides, pesticides, pharmaceuticals). Similarly, for specific uses in food contact materials and cosmetics, the EA does not need to address human exposures because these are addressed under the respective legislations.

4.6 CLP Information Requirements

The Title XI on Classification and Labelling Inventory was originally covered by REACH. At the end of 2008 it was moved to CLP[31] and now provides the general framework for the classification and labelling of substances (and mixtures) independently of their volume of production.

The classification, labelling and packaging of hazardous substances have to be notified generally by 3 January 2011 to the European Chemicals Agency (ECHA). ECHA will establish a CLP Inventory, containing the information provided in accordance with Article 40(1) of CLP. As already noted, CLP Article 9(5) requires that such information must take account of the different forms or physical states of the substance or mixture placed on the market and in which it can reasonably be expected to be used.

4.7 Information on Nanomaterials under REACH

It is possible to develop a wide range of scenarios as to whether relevant information on the use of nanomaterials will be provided by REACH.

Clearly, there are many substances due to be registered in 2010 which will require a CSA. For some of these, there may be a nano-form which may be explicitly included in the CSA. The simplest example is where a particular use is limited to the nano-form of the substance. In order to ensure that the EA contains the full range of uses of the substance, there will need to be a reference to that use which relies on the nano-form of the substance (although whether specific references to the term *nano* are made remains to be seen).

30 http://guidance.echa.europa.eu/chemical_safety_en.htm

31 According to the transitional arrangements, substances must be classified based on the CLP Regulation by 3 January 2011 and the information about the old classification has to be provided in the Safety Data Sheets until 1 June 2015. Mixtures must be classified based on the CLP Regulation by 2015.

However, there are many other scenarios where nano-specific information (on uses) may not be provided including:

- nano-form is used alongside non-nano-forms in particular uses. In the absence of specific guidance to the contrary, it is possible that some users (and/or manufacturers/suppliers) would highlight the use of nanomaterials;
- nano-form is used in products covered by other legislation (for example, use of nano-coatings in drink bottles or nanoparticles in cosmetics). In such cases, it is unlikely that the CSA would make reference to the associated safety/risk implications of such uses;
- nano-form is based on a substance which is not classified under DSD/CLP and therefore does not trigger an EA under REACH (see Box 1); and
- nano-form is based on a substance which is exempt from some provisions of REACH (polymers, biocides, very low tonnage compounds, etc.).

In summary, although it is likely that many of the nanomaterials in current (and near-future) use within the EU are associated with substances which will be registered prior to the 2010 deadline, there remains uncertainty as to whether information on all the specific uses of nanomaterials will be provided within the context of the REACH Regulation.

Even where detailed information is provided on the uses of nanomaterials, there remain considerable uncertainties over the associated risks – given the gaps in scientific knowledge in this area regarding the specific properties that may generate hazards, remaining uncertainties related to internationally agreed tests by which to assess these hazards and uncertainty on how to tackle exposure measurement particularly in the environment.

Nevertheless, the expected publication of the first registration dossiers in November 2009 (presumably including those for silica and carbon black) will provide a little more information on how the presence of nanomaterials is being dealt with under the REACH and CLP Regulations.

Box 1: Carbon Black (EC 215-609-9, CAS 1333-86-4)

The International Carbon Black Association states that carbon black: *is virtually pure elemental carbon in the form of colloidal particles that are produced by incomplete combustion or thermal decomposition of gaseous or liquid hydrocarbons under controlled conditions*
(*Source:* http://www.carbon-black.org/what_is.html).

Production of carbon black runs into millions of tonnes per year. The average aggregate particle diameters in several commercially produced carbon blacks range from 50 to 600 nm and the more loosely associated agglomerates can reach up to many micrometers in diameter (IARC, 2006). As such, carbon black contains nanomaterials (as defined).

Carbon black was pre-registered and, as of July 2009, has been successfully registered by a consortium with ECHA (see http://www.cb4reach.eu/).

The chemical safety report (CSR) did not include an Exposure Assessment on the grounds that carbon black is not classified as a hazardous material (within the EU).

The presence of nanomaterials in carbon black was dealt with as follows:
Carbon Black is a so-called "nano-structured material" (ISO TC 229, Draft TS 12921), i.e. consisting of primary particles formed in the carbon black process that combine within milliseconds after formation in the reactor to aggregates and agglomerates. Therefore a differentiation for Carbon Black between nano-material and bulk/conventional material is not necessary (*Source:* http://www.cb4reach.eu/index.php?id=faqonreachbyindustry).

5. KEY FINDINGS

5.1 Task 1 Objective

The objective of Task 1 was to analyse the European market for nanomaterials and establish:

- which are the main substances at the nanoscale currently on the market;
- whether and how these substances will be registered under REACH; and
- what relevant information will not become available (from the REACH process).

These issues have been addressed in this report and are briefly summarised below.

5.2 Nanomaterials on the Market

There is little doubt that nanomaterials may be found in a diverse range of products and applications across many sectors of the EU market. There are many other products and applications which are under research and development for both academic and commercial purposes.

It is important to stress that reliance has been placed on the claimed presence (or near-presence) of nanomaterials on the EU market by manufacturers and suppliers. As such, there are uncertainties as to the precise form in which such nanomaterials are present on the EU market and, indeed, whether there are other significant groups of nanomaterials on (or near to) the EU market which have not been identified in this report (or elsewhere).

The 'parent substances' of many nanomaterials are relatively common substances (silver, carbon, zinc oxide, silica, titanium dioxide and gold). As would be expected, there are many other parent substances including both inorganic compounds (including natural clays) and organic compounds (including polymers and biopolymers).

Currently, it appears that relatively few nanomaterials are used in a variety of products. Nevertheless, there is a considerable number of nanomaterials under research and development which may appear in industrial applications and production processes in due course.

5.3 Nanomaterials and REACH

Although nanomaterials are covered by the scope of the REACH and CLP Regulations, they are not specifically addressed in the Regulations, nor in the associated guidance issued by ECHA.

Some well established substances which incorporate nano-forms (including carbon black, silica and titanium dioxide) have been assigned EC numbers, pre-registered and, in some cases, registered under REACH as 'phase-in' (existing) substances. Conversely, no specific nano-substance (i.e. a substance which only exists in the nano-form) has been assigned an EC Number and therefore no such substance can be registered as a phase-in substance (in its own right).

Most of the other nanomaterials are forms of their 'parent substances' under which they are expected to be registered in accordance with REACH (and notified to the CLP Inventory of ECHA, generally by 3 January 2011).

One of the key findings is that the parent substances used in many nanomaterials have been pre-registered under REACH. Furthermore, in many cases, the associated registration is planned for 2010 (indicating production/import volumes above 1000 t/yr).

There appear to be two main groups of nanomaterials which will not be covered by REACH registration:

- those that are exempt from REACH such as those based on polymers (e.g. polyesters and PET) and biopolymers (such as micelles); and
- those manufactured/imported in very low volumes (less than the one tonne per year threshold) including, perhaps, some complex metal1-metal2-oxides which have not been pre-registered.

5.4 Information under REACH

The provisions of the REACH and CLP Regulations require that manufacturers and importers will notify, independently of the volumes, the classification and labelling of substances and mixtures on the market to ECHA generally by 3 January 2011 and register substances supplied in volumes of 1 tonne or more according to staggered timelines of REACH, and for the first time by 1 December 2010. Depending on the total tonnage, the registration dossier contains a technical dossier and a chemical safety assessment (the latter not for substances below 10 tpa).

Although it is possible that manufacturers/importers will submit hazard assessments (HA) which incorporate detailed information on physicochemical properties, toxicology and ecotoxicology on both the bulk and nano-forms of particular substances, further guidance from ECHA is likely to be required. An example of such specific guidance could be that further nano-specific properties (such as nature of nano-object or nanostructured material and associated dimensions, surface specific activity, etc.) could be provided within the HA.

In some cases, it may be determined that a full chemical safety assessment (CSA) is required (under REACH) in which the risks to human health and the environment are demonstrated to be controlled from consideration of the HA and an exposure assessment (EA) (including also risk management measures). There are, of course, a number of exemptions to these requirements including when the specific use of the substance is already regulated under more specific legislation (e.g. biocides, pesticides, pharmaceuticals). Similarly, for uses in food contact materials and cosmetics, the EA/CSA does not need to address human health aspects for those uses because these will be addressed under the respective legislation.

Even where detailed information is provided in the HA and EA for uses of nanomaterials, there remain considerable uncertainties over the potential risks – given the current lack of scientific knowledge in this area.

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ANNEX I:

EXAMPLES OF NANOMATERIALS IN THE EU

Examples of Nanomaterials in Products in the EU

ID 61

PARENT (Common)

CAS No.
EC No.

PARENT (Not Common) Carotenoids (e.g. lycopene)

CAS No. Not listed
EC No. Not listed

Type 3D - nanoparticles (nanopowders/fullerenes)

Nano-Structured Material (NSM)? No

Nano CAS No. Not listed

Nano EC No. Not listed

Description
Colouring pigment and health-promoting substance - used to encapsulate vitamins in food and drinks

Exact Product Code (Example)

Product Category
10 Food products

Example Companies-Products

EU Status Current

Comment on Use Produced in EU

Companies include: BASF (Germany); Chr. Hansen (Denmark) and DMS (Netherlands)

Information Source
http://www.ta-swiss.ch/a/nano_nafo/KF_Nano_im_Lebensmittelbereich.pdf ; ftp://ftp.cordis.europa.eu/pub/food/docs/iden-r_en.pdf

ID 60

PARENT (Common)

CAS No.
EC No.

PARENT (Not Common) Micelles

CAS No. Not listed
EC No. Not listed

Type 3D - nanoparticles (nanopowders/fullerenes)

Nano-Structured Material (NSM)? No

Nano CAS No. Not listed

Nano EC No. Not listed

Description
Encapsulation of vitamins,Omega-3 fatty acids, essential oils, co-enzyme Q10 and other substances in products

Exact Product Code (Example)

Product Category
10 Food products

Example Companies-Products

EU Status Current

Comment on Use Produced in EU (but withdrawn in Switzerland)

AquaNova (Germany); Shemen Industries (Israel)

Information Source
http://www.aquanova.de/ ; http://www.ta-swiss.ch/a/nano_nafo/KF_Nano_im_Lebensmittelbereich.pdf;

Examples of Nanomaterials in Products in the EU

ID 67

PARENT (Common)

CAS No.
EC No.

PARENT (Not Common) Ferric pyrophosphate

CAS No. 10058-44-3
EC No. 233-190-0

Type 3D - nanoparticles (nanopowders/fullerenes)

Nano-Structured Material (NSM)? No

Nano CAS No. Not listed

Nano EC No. Not listed

Description
Improve absorption of iron particles by the human body

Exact Product Code (Example)

Product Category
10 Food products

Example Companies-Products

EU Status Near-future

Comment on Use Used in some Asian and African countries

SunActive Fe (Japan)

Information Source
http://www.ta-swiss.ch/a/nano_nafo/KF_Nano_im_Lebensmittelbereich.pdf

ID 62

PARENT (Common)

CAS No.
EC No.

PARENT (Not Common) "iron-whey"

CAS No.
EC No.

Type 3D - nanoparticles (nanopowders/fullerenes)

Nano-Structured Material (NSM)? No

Nano CAS No. Not listed

Nano EC No. Not listed

Description
Iron-whey nanoparticulates for delivery systems

Exact Product Code (Example)

Product Category
10 Food products

Example Companies-Products

EU Status Near-future

Comment on Use Produced overseas

Snow Brand Milk Produce Co. (Japan)

Information Source
http://www.observatorynano.eu/project/document/41/

Examples of Nanomaterials in Products in the EU

ID 58

PARENT (Common): CAS No.: EC No.:

PARENT (Not Common): Chitosan tripolyphosphate CAS No.: Not listed EC No.: Not listed

Type: 3D - nanoparticles (nanopowders/fullerenes)

Nano-Structured Material (NSM)?: No (probably)

Nano CAS No.: Not listed

Nano EC No.: Not listed

Description: Chitosan (derived from shrimp shells) tripolypohosphate nanoparticles used to enhance green tea

Exact Product Code (Example): 10.83.13 Green tea (not fermented), black tea (fermented) and partly fermented tea, in immediate packings of a content • 3 kg

Product Category: 10 Food products

Example Companies-Products:

EU Status: Research

Comment on Use: R&D in China

Information Source: http://www.nutraingredients.com/Research/Green-tea-catechins-go-nano-study

ID 57

PARENT (Common): Silica CAS No.: 7631-86-9 EC No.: 231-545-4

PARENT (Not Common): CAS No.: EC No.:

Type: 3D - nanoparticles (nanopowders/fullerenes)

Nano-Structured Material (NSM)?: No (probably)

Nano CAS No.: Not listed

Nano EC No.: Not listed

Description: Anti-caking agent for condiments / spices

Exact Product Code (Example): 10.84.12 Sauces; mixed condiments and mixed seasonings; mustard flour and meal and prepared mustard

Product Category: 10 Food products

Example Companies-Products:

EU Status: Current

Comment on Use: One of the few nano-food additives

Information Source: http://nanodialog.eu/index.php?option=com_content&task=view&id=55&Itemid=38

Examples of Nanomaterials in Products in the EU

ID 51

PARENT (Common): CAS No.: EC No.:

PARENT (Not Common): Polyester liquid CAS No.: EC No.:

Type: Not determined

Nano-Structured Material (NSM)?: No (probably)

Nano CAS No.: Not listed

Nano EC No.: Not listed

Description: Various products including those which enhance stain/spill resistance of soft furnishings, and those which provide a semi-impervious layer that traps fluids and particles so they can be washed away (used for mattresses)

Exact Product Code (Example): 13.92.12 Bed linen

Product Category: 13 Textiles

Example Companies-Products: Nano-tex (US company)

EU Status: Current

Comment on Use:

Information Source: www.nano-tex.com

ID 49

PARENT (Common): Silver CAS No.: 7440-22-4 EC No.: 231-131-3

PARENT (Not Common): CAS No.: EC No.:

Type: 3D - nanoparticles (nanopowders/fullerenes)

Nano-Structured Material (NSM)?: No (probably)

Nano CAS No.: Not listed

Nano EC No.: Not listed

Description: Use of nano silver for anti microbial and antifungal properties in gym towels

Exact Product Code (Example): 13.20.42 Terry towelling and similar woven terry fabrics (other than narrow fabrics) of cotton

Product Category: 13 Textiles

Example Companies-Products: AgActive

EU Status: Current

Comment on Use: Widely available

Information Source: http://www.agactive.co.uk/index.cfm/fuseaction/product.display/Product_ID/7/.htm

Examples of Nanomaterials in Products in the EU

ID 56

PARENT (Common) Carbon — **CAS No.** 7440-44-0 — **EC No.** 231-153-3

PARENT (Not Common) — **CAS No.** — **EC No.**

Type 2DS - solid nanofibes (nanorods)

Nano-Structured Material (NSM)? No

Nano CAS No. Not listed

Nano EC No. Not listed

Description
Carbon fibres derived from bamboo charcoal (hence bamboo-carbon) added to textiles to improve durability, washability as well providing an antimicrobial function

Product Category
14 Wearing apparel

Exact Product Code (Example)
14.31.10 Panty hose, tights, stockings, socks and other hosiery, knitted or crocheted

EU Status Current

Comment on Use Probably imported to EU

Example Companies-Products
Greenyarn (US)

Information Source
http://www.greenyarn.com/technology.htm, and article from *China Textile* magazine: http://news.alibaba.com/article/detail/textiles/100105134-2-study-applications-nanotechnolongy-bamboo-charcoal.html

ID 50

PARENT (Common) Silver — **CAS No.** 7440-22-4 — **EC No.** 231-131-3

PARENT (Not Common) — **CAS No.** — **EC No.**

Type 3D - nanoparticles (nanopowders/fullerenes)

Nano-Structured Material (NSM)? No (probably)

Nano CAS No. Not listed

Nano EC No. Not listed

Description
Use of nano silver for anti microbial and antifungal properties in socks

Product Category
14 Wearing apparel

Exact Product Code (Example)
14.31.10 Panty hose, tights, stockings, socks and other hosiery, knitted or crocheted

EU Status Current

Comment on Use Widely available

Example Companies-Products
AgActive

Information Source
http://www.agactive.co.uk/

Examples of Nanomaterials in Products in the EU

ID 68

PARENT (Common) — **CAS No.** — **EC No.**

PARENT (Not Common) Potassium manganese oxide — **CAS No.** Not listed — **EC No.** Not listed

Type 2DS - solid nanofibes (nanorods)

Nano-Structured Material (NSM)? No

Nano CAS No. Not listed

Nano EC No. Not listed

Description
Paper from an interwoven mesh of nanowires that is able to selectively absorb hydrophobic (oil-like) liquids from water

Product Category
17 Paper and paper products

Exact Product Code (Example)
17.12.43 Filter paper and paperboard; felt paper

EU Status Research

Comment on Use US Research

Example Companies-Products

Information Source
http://web.mit.edu/newsoffice/2008/oil-paper-0530.html

ID 69

PARENT (Common) — **CAS No.** — **EC No.**

PARENT (Not Common) Cerium oxide — **CAS No.** 11129-18-3 — **EC No.** 234-374-3

Type 3D - nanoparticles (nanopowders/fullerenes)

Nano-Structured Material (NSM)? No (probably)

Nano CAS No. Not listed

Nano EC No. Not listed

Description
Diesel fuel additive used to save fuel, reduce emission and clean engine

Product Category
20 Chemicals and chemical products

Exact Product Code (Example)
20.59.42 Anti-knock preparations; additives for mineral oils and similar products

EU Status Current

Comment on Use

Example Companies-Products
Oxonica-Envirox (UK)

Information Source
http://www.oxonica.com/energy/energy_envirox_intro.php

Examples of Nanomaterials in Products in the EU

ID 66

PARENT (Common)

CAS No. **EC No.**

PARENT (Not Common) Alumina — **CAS No.** 1344-28-1 — **EC No.** 215-691-6

Type 3D - nanoparticles (nanopowders/fullerenes)

Description Use of alumina (and, in a similar product, silica) in sprays to form a water repellent coating for wood

Nano-Structured Material (NSM)? No

Nano CAS No. Not listed

Nano EC No. Not listed

Exact Product Code (Example) 20.30.2 Other paints and varnishes and related products; artists' colour and printing ink

Product Category 20 Chemicals and chemical products

Example Companies-Products BASF

EU Status Current

Comment on Use Similar products available

Information Source www.nanoforum.org (*Nanotechnology and Construction*)

ID 55

PARENT (Common)

CAS No. **EC No.**

PARENT (Not Common) Calcium Peroxide — **CAS No.** 1305-79-9 — **EC No.** 215-139-4

Type 3D - nanoparticles (nanopowders/fullerenes)

Description Nano particles used in whitening toothpaste

Nano-Structured Material (NSM)? No (probably)

Nano CAS No. Not listed

Nano EC No. Not listed

Exact Product Code (Example) 20.42.18 Preparations for oral or dental hygiene (including denture fixative pastes and powders), dental floss

Product Category 20 Chemicals and chemical products

Example Companies-Products Swiss Dent Nano (UK)

EU Status Current

Comment on Use

Information Source http://www.beautybay.com/cosmetics/swissdent/nanowhiteningtoothpaste/

Examples of Nanomaterials in Products in the EU

ID 44

PARENT (Common)

CAS No. **EC No.**

PARENT (Not Common) Polyethylene terephthalate (PET) — **CAS No.** 25038-59-9 — **EC No.** Not listed

Type 1D - nanoplates (nanoscale films/coatings)

Description Multi layers of PET (each <5nm) provide strength, heat resistance, etc. for coatings for windows, buildings, LCDs, etc

Nano-Structured Material (NSM)? No

Nano CAS No. Not listed

Nano EC No. Not listed

Exact Product Code (Example) 20.16.10 Polymers of ethylene, in primary forms

Product Category 20 Chemicals and chemical products

Example Companies-Products Toray

EU Status Current

Comment on Use Global company has facilities in Europe

Information Source http://www.toray.com/technology/nano/nan_002.html

ID 29

PARENT (Common)

CAS No. **EC No.**

PARENT (Not Common) Tungsten disulphide — **CAS No.** 12138-09-9 — **EC No.** 235-243-3

Type 3D - nanoparticles (nanopowders/fullerenes)

Description Nanoparticles of tungsten disulfide (WS--2) in oil suspension, used as lubricant in vehicle engines & greases

Nano-Structured Material (NSM)? No (probably)

Nano CAS No. Not listed

Nano EC No. Not listed

Exact Product Code (Example) 20.59.4 Lubricating preparations; additives; anti-freezing preparations

Product Category 20 Chemicals and chemical products

Example Companies-Products ApNano Materials, Inc.
NanoLub® RCX

EU Status Current

Comment on Use US Company marketing

Information Source http://www.apnano.com/ShowDoc.asp?ID=836

Examples of Nanomaterials in Products in the EU

ID 70

PARENT (Common)

CAS No.
EC No.

PARENT (Not Common) Molybdenum disulphide

CAS No. 1309-56-4
EC No. 215-172-4

Type 3D - nanoparticles (nanopowders/fullerenes)

Nano-Structured Material (NSM)? No

Nano CAS No. Not listed

Nano EC No. Not listed

Description
Nanospheres of MoS2 (and also tungsten and nobium sulphides) provide enahnced lubrication for engines and other applications

Exact Product Code (Example)
20.59.41 Lubricating preparations

Product Category
20 Chemicals and chemical products

Example Companies-Products
Apnano - NanoLub (US/Israel)

EU Status Near-future

Comment on Use Marketed by US/Israel company

Information Source
http://www.apnano.com/default.asp

ID 43

PARENT (Common)

CAS No.
EC No.

PARENT (Not Common) "polyesters"

CAS No. Not known
EC No. Not known

Type 3D - nanoparticles (nanopowders/fullerenes)

Nano-Structured Material (NSM)? Possibly

Nano CAS No. Not listed

Nano EC No. Not listed

Description
Next generation toner for Xerox for desktop printers, etc. features nanoscale polyesters mixed with pgments and wax to produce an "ultra low-melt EA (emulsion aggregation) toner"

Exact Product Code (Example)
20.59.12 Sensitising emulsions for photographic uses; chemical preparations for photographic uses n.e.c.

Product Category
20 Chemicals and chemical products

Example Companies-Products
Fuji/Xerox

EU Status Near-future

Comment on Use Commercial production in Canada due 2009

Information Source
www.xerox.com/go/xrx/template/inv_rel_newsroom.jsp?ed_name=CAN_News_11_18_2008&app=Newsroom&view=newsrelease&format=article&Xcntry=CAN&Xlang=en_CA

Examples of Nanomaterials in Products in the EU

ID 42

PARENT (Common)

CAS No.
EC No.

PARENT (Not Common) Unknown

CAS No. Not known
EC No. Not known

Type 1D - nanoplates (nanoscale films/coatings)

Nano-Structured Material (NSM)? No

Nano CAS No. Not listed

Nano EC No. Not listed

Description
Nanoplate catalysts coatings for oil & gas processing (with specific reference to olefin production)

Exact Product Code (Example)
20.59.56 Pickling preparations; fluxes; prepared rubber accelerators; compound plasticisers and stabilisers for rubber or plastics; **catalytic preparations n.e.c.**; mixed alkylbenzenes and mixed alkylnaphthalenes n.e.c

Product Category
20 Chemicals and chemical products

Example Companies-Products
Quantiam Technologies

EU Status Near-future

Comment on Use Near full-scale production plants in Canada

Information Source
http://www.naceedmonton.com/pdfs/ASM_Edmonton_April_Meeting_Notice.pdf

ID 41

PARENT (Common)

CAS No.
EC No.

PARENT (Not Common) Ruthenium

CAS No. 7440-18-8
EC No. 231-127-1

Type 3D - nanoparticles (nanopowders/fullerenes)

Nano-Structured Material (NSM)? No

Nano CAS No. Not known

Nano EC No. Not listed

Description
Use of ruthenium nanoparticles on carbon will improve performance of rutheium catalysts in hydrogenation reactions

Exact Product Code (Example)
20.59.56 Pickling preparations; fluxes; prepared rubber accelerators; compound plasticisers and stabilisers for rubber or plastics; **catalytic preparations n.e.c.**; mixed alkylbenzenes and mixed alkylnaphthalenes n.e.c

Product Category
20 Chemicals and chemical products

Example Companies-Products

EU Status Near-future

Comment on Use Use of non-nano ruthenium catalyst is well established

Information Source
www.nanowerk.com/spotlight/spotid=2680.php

Examples of Nanomaterials in Products in the EU

ID 8

PARENT (Common)

CAS No.
EC No.

PARENT (Not Common) Molybdenum disulphide

CAS No. 1309-56-4
EC No. 215-172-4

Type 3D - nanoparticles (nanopowders/fullerenes)

Nano-Structured Material (NSM)? No (probably)

Nano CAS No. Not listed

Nano EC No. Not listed

Description
MoS2 nanoparticles have a potentially important application as a catalyst for producing sulphur-free fuels.

Exact Product Code (Example)
20.59.42 Anti-knock preparations; additives for mineral oils and similar products (?)

Product Category
20 Chemicals and chemical products

Example Companies-Products

EU Status Research

Comment on Use Research at Forschungszentrum Dresden-Rossendorf

Information Source
http://www.azonano.com/News.asp?NewsID=3679

ID 6

PARENT (Common) Carbon

CAS No. 7440-44-0
EC No. 231-153-3

PARENT (Not Common)

CAS No.
EC No.

Type 3D - nanoparticles (nanopowders/fullerenes)

Nano-Structured Material (NSM)? No (probably)

Nano CAS No. Not listed

Nano EC No. Not listed

Description
Fullerenes used as UV filter in sunscreens

Exact Product Code (Example)
20.42.15 Beauty, make-up or skin-care preparations (including sun tan preparations) n.e.c.

Product Category
20 Chemicals and chemical products

Example Companies-Products
L'Oreal, Dr Brandt

EU Status Current

Comment on Use Widely used in the EU

Information Source
http://www.which.co.uk/about-which/press/campaign-press-releases/other-issues/2008/11/beauty-must-face-up-to-nano.jsp

Examples of Nanomaterials in Products in the EU

ID 3

PARENT (Common) Carbon

CAS No. 7440-44-0
EC No. 231-153-3

PARENT (Not Common)

CAS No.
EC No.

Type 3D - nanoparticles (nanopowders/fullerenes)

Nano-Structured Material (NSM)? No

Nano CAS No. Not listed

Nano EC No. Not listed

Description
Buckyballs used to prevent biofouling of water treatment membrancs

Exact Product Code (Example)
Not known

Product Category
20 Chemicals and chemical products

Example Companies-Products

EU Status Research

Comment on Use University research (USA)

Information Source
www.nanowerk.com/news/newsid=9770.php

ID 65

PARENT (Common) Carbon Black

CAS No. 1333-86-4
EC No. 215-609-9

PARENT (Not Common)

CAS No.
EC No.

Type 3D - nanoparticles (nanopowders/fullerenes)

Nano-Structured Material (NSM)? No

Nano CAS No. 1333-86-4

Nano EC No. 215-609-9

Description
Carbon black used in printer toner

Exact Product Code (Example)
20.30.24 Printing ink

Product Category
20 Chemicals and chemical products

Example Companies-Products

EU Status Current

Comment on Use Established use

Information Source
www.nanoforum.org (*Nanotechnology in Consumer Products*)

Examples of Nanomaterials in Products in the EU

ID 7

PARENT (Common) Gold — **CAS No.** 7440-57-5 — **EC No.** 231-165-9

PARENT (Not Common) Palladium — **CAS No.** 7440-05-3 — **EC No.** 231-115-6

Type 3D - nanoparticles (nanopowders/fullerenes)

Nano-Structured Material (NSM)? No (probably)

Nano CAS No. Not listed

Nano EC No. Not listed

Description

Gold-palladium nanoparticles used to improve hydrogen peroxide production process

Product Category

20 Chemicals and chemical products

Exact Product Code (Example)

20.59.56 Pickling preparations; fluxes; prepared rubber accelerators; compound plasticisers and stabilisers for rubber or plastics; **catalytic preparations n.e.c.**; mixed alkylbenzenes and mixed alkylnaphthalenes n.e.c.

EU Status Research

Comment on Use EU-funded research at Cardiff University

Example Companies-Products

Information Source

www.nanotech-now.com/news.cgi?story_id=32260

ID 48

PARENT (Common) Silica — **CAS No.** 7631-86-9 — **EC No.** 231-545-4

PARENT (Not Common) — **CAS No.** — **EC No.**

Type 3D - nanoparticles (nanopowders/fullerenes)

Nano-Structured Material (NSM)? No (probably)

Nano CAS No. Not listed

Nano EC No. Not listed

Description

Use of silica (along with 'ceramics', 'diamond' and 'silver') in water/alcohol sprays to form multi-nanolayer sealants for a very wide range of products (cars, windows, external wood, etc.). (*Many other products use just nano-silica to provide coatings*)

Product Category

20 Chemicals and chemical products

Exact Product Code (Example)

20.30.2 Other paints and varnishes and related products; artists' colour and printing ink

EU Status Current

Comment on Use Wide range of products available

Example Companies-Products

Percenta AG (Germany)

Information Source

http://en.percenta.com/nanotechnology-facts.php

Examples of Nanomaterials in Products in the EU

ID 54

PARENT (Common) Silver — **CAS No.** 7440-22-4 — **EC No.** 231-131-3

PARENT (Not Common) — **CAS No.** — **EC No.**

Type 3D - nanoparticles (nanopowders/fullerenes)

Nano-Structured Material (NSM)? No (probably)

Nano CAS No. Not listed

Nano EC No. Not listed

Description

Nano particles of silver for personal hygiene products (mouthwash gel, spray and liquid)

Product Category

20 Chemicals and chemical products

Exact Product Code (Example)

20.42.18 Preparations for oral or dental hygiene (including denture fixative pastes and powders), dental floss

EU Status Current

Comment on Use Available in EU

Example Companies-Products

Dentasil (CZ)

Information Source

http://www.nanosilver.it/eng/applicazioni.htm, http://www.altermed.eu/en/catalog/dentasil

ID 4

PARENT (Common) Titanium Dioxide — **CAS No.** 13463-67-7 — **EC No.** 236-675-5

PARENT (Not Common) — **CAS No.** — **EC No.**

Type 3D - nanoparticles (nanopowders/fullerenes)

Nano-Structured Material (NSM)? Yes (probably)

Nano CAS No. Not listed

Nano EC No. Not listed

Description

Nano TiO2 used as UV filter in sunscreens

Product Category

20 Chemicals and chemical products

Exact Product Code (Example)

20.42.15 Beauty, make-up or skin-care preparations (including sun tan preparations) n.e.c.

EU Status Current

Comment on Use Widely used in the EU

Example Companies-Products

L'Oreal, Dr Brandt

Information Source

http://www.which.co.uk/about-which/press/campaign-press-releases/other-issues/2008/11/beauty-must-face-up-to-nano.jsp

Examples of Nanomaterials in Products in the EU

ID 5

PARENT (Common) Zinc Oxide — **CAS No.** 1314-13-2 — **EC No.** 215-222-5

PARENT (Not Common) — **CAS No.** — **EC No.**

Type 3D - nanoparticles (nanopowders/fullerenes)

Nano-Structured Material (NSM)? Yes (probably)

Nano CAS No. Not listed

Nano EC No. Not listed

Description
Nano ZnO used as UV filter in sunscreens

Exact Product Code (Example)
20.42.15 Beauty, make-up or skin-care preparations (including sun tan preparations) n.e.c.

Product Category
20 Chemicals and chemical products

Example Companies-Products
L'Oreal, Dr Brandt

EU Status Current

Comment on Use Widely used in the EU

Information Source
http://www.which.co.uk/about-which/press/campaign-press-releases/other-issues/2008/11/beauty-must-face-up-to-nano.jsp

ID 59

PARENT (Common) — **CAS No.** — **EC No.**

PARENT (Not Common) Chitosan tripolyphosphate — **CAS No.** Not listed — **EC No.** Not listed

Type 3D - nanoparticles (nanopowders/fullerenes)

Nano-Structured Material (NSM)? No

Nano CAS No. Not listed

Nano EC No. Not listed

Description
Chitosan (derived from shrimp shells) tripolypohosphate nanoparticles used to assist with drug delivery to the skin

Exact Product Code (Example)
21.20.23 Diagnostic reagents and other pharmaceutical preparations

Product Category
21 Basic pharmaceutical products and pharmaceutical preparations

Example Companies-Products

EU Status Research

Comment on Use R&D in Austria

Information Source
www.scipharm.at/download.asp?id=408

Examples of Nanomaterials in Products in the EU

ID 2

PARENT (Common) — **CAS No.** — **EC No.**

PARENT (Not Common) Biopolymeric — **CAS No.** Not listed — **EC No.** Not listed

Type 3D - nanoparticles (nanopowders/fullerenes)

Nano-Structured Material (NSM)? No

Nano CAS No. Not listed

Nano EC No. Not listed

Description
Nano-sized “trojan horse” particle to ensure healing antioxidants can be better absorbed by the human body.

Exact Product Code (Example)
Not known

Product Category
21 Basic pharmaceutical products and pharmaceutical preparations

Example Companies-Products

EU Status Research

Comment on Use University research (Australia)

Information Source
http://www.foodprocessing.com/articles/2008/377.html

ID 9

PARENT (Common) Gold — **CAS No.** 7440-57-5 — **EC No.** 231-165-9

PARENT (Not Common) — **CAS No.** — **EC No.**

Type 3D - nanoparticles (nanopowders/fullerenes)

Nano-Structured Material (NSM)? No

Nano CAS No.

Nano EC No.

Description
Hollow gold nanospheres equipped with a targeting peptide find melanoma cells and provide the potentailf or cancer treatment

Exact Product Code (Example)
21.20.23 Diagnostic reagents and other pharmaceutical preparations

Product Category
21 Basic pharmaceutical products and pharmaceutical preparations

Example Companies-Products

EU Status Research

Comment on Use US Research at Univeristy of Texas

Information Source
http://www.sciencedaily.com/releases/2009/02/090202074856.htm

Examples of Nanomaterials in Products in the EU

ID 63

PARENT (Common) Silver — **CAS No.** 7440-22-4 — **EC No.** 231-131-3

PARENT (Not Common) — **CAS No.** — **EC No.**

Type 3D - nanoparticles (nanopowders/fullerenes)

Nano-Structured Material (NSM)? No

Nano CAS No. Not listed

Nano EC No. Not listed

Description
Spray on female contraceptive using nano-silver as a spermicide

Product Category
21 Basic pharmaceutical products and pharmaceutical preparations

Exact Product Code (Example)
21.20.22 Chemical contraceptive preparations based on hormones or spermicides

EU Status Current

Comment on Use Company has EU distributers for its products

Example Companies-Products
Blue Cross Foam Condom (from China)

Information Source
http://www.bcbmcn.com/Products/p_l_02.htm

ID 46

PARENT (Common) Silver — **CAS No.** 7440-22-4 — **EC No.** 231-131-3

PARENT (Not Common) — **CAS No.** — **EC No.**

Type 1D - nanoplates (nanoscale films/coatings)

Nano-Structured Material (NSM)? No

Nano CAS No. Not listed

Nano EC No. Not listed

Description
Nanosilver used as an antic-microbial agent in protective coatings on medical products (implants, dressings, etc.)

Product Category
21 Basic pharmaceutical products and pharmaceutical preparations

Exact Product Code (Example)
21.20.24 Adhesive dressings, catgut and similar materials; first-aid boxes

EU Status Current

Comment on Use Products available on EU market

Example Companies-Products
Bio-gate (Germany)

Information Source
http://www.bio-gate.de/page.asp?lang=e&main=0&did=503&sec=1&third=1

Examples of Nanomaterials in Products in the EU

ID 71

PARENT (Common) Carbon Black — **CAS No.** 1333-86-4 — **EC No.** 215-609-9

PARENT (Not Common) — **CAS No.** — **EC No.**

Type 3D - nanoparticles (nanopowders/fullerenes)

Nano-Structured Material (NSM)? Yes

Nano CAS No. 1333-86-4

Nano EC No. 215-609-9

Description
Carbon black used in vehicle tyres

Product Category
22 Rubber and plastics products

Exact Product Code (Example)
22.11 Rubber tyres and tubes; retreading and rebuilding of rubber tyres

EU Status Current

Comment on Use Established use

Example Companies-Products

Information Source
http://www.carbon-black.org/what_is.html

ID 45

PARENT (Common) — **CAS No.** — **EC No.**

PARENT (Not Common) Montmorillonite — **CAS No.** 1318-93-0 — **EC No.** 215-288-5

Type 1D - nanoplates (nanoscale films/coatings)

Nano-Structured Material (NSM)? Yes

Nano CAS No. 1318-93-0

Nano EC No. 215-288-5

Description
Montmorillonite is a natural clay mineral with nanoplate structure. Such nanoclays may be mixed with other polymers to produce nanocomposites

Product Category
23 Other non-metallic mineral products

Exact Product Code (Example)
23.99.19 Non-metallic mineral products n.e.c.

EU Status Current

Comment on Use Wide range of nanoclays and nanocomposites in use

Example Companies-Products
Nanocor (in China) produces nanoclays and nanocomposites - including Imperm used as a coating for drink bottles in the EU

Information Source
http://www.nanocor.com/nano_struct.asp

Examples of Nanomaterials in Products in the EU

ID 53

PARENT (Common) Titanium Dioxide — **CAS No.** 13463-67-7 — **EC No.** 236-675-5

PARENT (Not Common) — **CAS No.** — **EC No.**

Type 3D - nanoparticles (nanopowders/fullerenes)

Nano-Structured Material (NSM)? Possibly

Nano CAS No. Not listed

Nano EC No. Not listed

Description
TiO2 particles applied to ceramic tiles to facilitate design and durability. (see also Entry 38)

Product Category
23 Other non-metallic mineral products

Exact Product Code (Example)
23.31.10 Ceramic tiles and flags

EU Status Current

Comment on Use Various EU manufacturers/importers

Example Companies-Products
Dahlia Design (Singapore), Lasselsberger

Information Source
http://nanotio2tiles.com/products.html, http://www.rako.cz

ID 64

PARENT (Common) — **CAS No.** — **EC No.**

PARENT (Not Common) Phosphorous — **CAS No.** 7723-14-0 — **EC No.** 231-768-7

Type 3D - nanoparticles (nanopowders/fullerenes)

Nano-Structured Material (NSM)? No

Nano CAS No. Not listed

Nano EC No. Not listed

Description
Phopshorous nano-spheres within copper and copper-silver alloys used as brazing metal

Product Category
24 Basic metals

Exact Product Code (Example)
24.44.13 Refined copper and copper alloys, unwrought; master alloys of copper

EU Status Current

Comment on Use Italian products marketed in EU

Example Companies-Products
NanoTech Alloys (Pietro Galliani Brazing)

Information Source
http://www.prensa.ifema.es/SalaPrensa/img_noticia/NanoTechflyer.pdf

Examples of Nanomaterials in Products in the EU

ID 52

PARENT (Common) — **CAS No.** — **EC No.**

PARENT (Not Common) Iron — **CAS No.** 231-096-4 — **EC No.** 7439-89-6

Type 3D - nanoparticles (nanopowders/fullerenes)

Nano-Structured Material (NSM)? No

Nano CAS No. Not listed

Nano EC No. Not listed

Description
Aqueous dispersion of zero-valent iron nanoparticles intended for groundwater remediation

Product Category
24 Basic metals

Exact Product Code (Example)
24.10.14 Granules and powders, of pig iron and spiegeleisen, or steel (??)

EU Status Current

Comment on Use Capacity in excess of 100 tpa

Example Companies-Products
Nanofer (from Czech Nano Iron company)

Information Source
www.nanoiron.cz

ID 10

PARENT (Common) — **CAS No.** — **EC No.**

PARENT (Not Common) Titanium — **CAS No.** 7440-32-6 — **EC No.** 231-142-3

Type 3D - nanoparticles (nanopowders/fullerenes)

Nano-Structured Material (NSM)? Yes (probably)

Nano CAS No. Not listed

Nano EC No. Not listed

Description
Used in fabrication of metal components by a metal injection molding (MIM) process

Product Category
25 Fabricated metal products, except machinery and equipment

Exact Product Code (Example)

EU Status Current (?)

Comment on Use Produced by a Canadian company

Example Companies-Products
AP&C Advanced Powders and Coatings Inc

Information Source
http://www.voyle.net/Nano%20Products%202005/Products%202005-0061.htm

Examples of Nanomaterials in Products in the EU

ID 26

PARENT (Common)

CAS No.
EC No.

PARENT (Not Common) Tungsten

CAS No. 7440-33-7
EC No. 231-143-9

Type 3D - nanoparticles (nanopowders/fullerenes)

Nano-Structured Material (NSM)? No

Nano CAS No. Not listed

Nano EC No. Not listed

Description
The proprietary process produces a coating containing the nano-particle (powdered tungsten) for the lining of a shaped charge (i.e. for armour penetrating projectiles)

Product Category
25 Fabricated metal products, except machinery and equipment

Exact Product Code (Example)
25.40.13 Bombs, missiles and similar munitions of war; cartridges, other ammunition and projectiles and parts thereof

EU Status Near-future

Comment on Use European Patent

Example Companies-Products
QINETIQ LTD

Information Source
http://v3.espacenet.com/publicationDetails/biblio?CC=EP&NR=1444477&KC=&FT=E

ID 17

PARENT (Common)

CAS No.
EC No.

PARENT (Not Common) Gadolinium

CAS No. 7440-54-2
EC No. 231-160-1

Type 2DS - solid nanofibes (nanorods)

Nano-Structured Material (NSM)? No

Nano CAS No. Not listed

Nano EC No. Not listed

Description
Production of Gadolinium nanowires using carbon nanotubes as templates

Product Category
25 Fabricated metal products, except machinery and equipment

Exact Product Code (Example)
25.93.15 Wire, rods, tubes, plates, electrodes, coated or cored with flux material

EU Status Research

Comment on Use University research (Japan)

Example Companies-Products

Information Source
http://ecsmeet5.peerx-press.org/ms_files/ecsmeet5/2007/12/21/00001685/00/1685_0_art_0_jt17xh.pdf

Examples of Nanomaterials in Products in the EU

ID 11

PARENT (Common) Carbon

CAS No. 7440-44-0
EC No. 231-153-3

PARENT (Not Common)

CAS No.
EC No.

Type Not determined

Nano-Structured Material (NSM)? Yes

Nano CAS No.

Nano EC No.

Description
Injection molding of carbon nano material and resin binder then molten low MP metal to form composite metal with improved properties

Product Category
25 Fabricated metal products, except machinery and equipment

Exact Product Code (Example)

EU Status Near-future

Comment on Use US patent

Example Companies-Products

Information Source
http://www.freepatentsonline.com/6874563.html

ID 16

PARENT (Common) Silver

CAS No. 7440-22-4
EC No. 231-131-3

PARENT (Not Common)

CAS No.
EC No.

Type 3D - nanoparticles (nanopowders/fullerenes)

Nano-Structured Material (NSM)? No

Nano CAS No. Not listed

Nano EC No. Not listed

Description
Deposition of fine silver particles on DNA molecules to form metal nanowires by electroless plating

Product Category
25 Fabricated metal products, except machinery and equipment

Exact Product Code (Example)
25.93.15 Wire, rods, tubes, plates, electrodes, coated or cored with flux material

EU Status Research

Comment on Use University research (Japan)

Example Companies-Products

Information Source
http://www.nanonet.go.jp/english/mailmag/2005/045b.html

Examples of Nanomaterials in Products in the EU

ID 14

PARENT (Common) Silver — **CAS No.** 7440-22-4 — **EC No.** 231-131-3

PARENT (Not Common) — **CAS No.** — **EC No.**

Type 2DS - solid nanofibes (nanorods)

Description Fabrication of silver/tungsten nanowires using an E-beam on metal nanoparticles to form nano-gap electrodes

Nano-Structured Material (NSM)? No

Nano CAS No. Not listed

Nano EC No. Not listed

Exact Product Code (Example) 25.93.15 Wire, rods, tubes, plates, electrodes, coated or cored with flux material

Product Category 25 Fabricated metal products, except machinery and equipment

Example Companies-Products

EU Status Research

Comment on Use University research (US)

Information Source http://www.nnin.org/doc/2004NNINreuBastianon.pdf

ID 22

PARENT (Common) — **CAS No.** — **EC No.**

PARENT (Not Common) Niobium — **CAS No.** 7440-03-1 — **EC No.** 231-113-5

Type 1D - nanoplates (nanoscale films/coatings)

Description Manufactured from thin-films of the metals using nano-lithography techniques to produce 500 x 100 nm bolometer (for radiation measurement)

Nano-Structured Material (NSM)? No

Nano CAS No. Not listed

Nano EC No. Not listed

Exact Product Code (Example) 26.51.66 Measuring or checking instruments, appliances and machines n.e.c.

Product Category 26 Computer, electronic and optical products

Example Companies-Products

EU Status Research

Comment on Use University research (US)

Information Source http://www.bio-medicine.org/biology-technology-1/Nano-sized-electronic-circuit-promises-bright-view-of-early-universe-6502-2/

Examples of Nanomaterials in Products in the EU

ID 13

PARENT (Common) — **CAS No.** — **EC No.**

PARENT (Not Common) Tungsten — **CAS No.** 7440-33-7 — **EC No.** 231-143-9

Type 1D - nanoplates (nanoscale films/coatings)

Description Fabrication of nano scale temperature sensors and nano scale heaters by focus of Ga+ ion beam to decompose W(CO)6 film

Nano-Structured Material (NSM)? No

Nano CAS No. Not listed

Nano EC No. Not listed

Exact Product Code (Example) 26.51.51 Hydrometers, thermometers, pyrometers, barometers, hygrometers and psychrometers

Product Category 26 Computer, electronic and optical products

Example Companies-Products

EU Status Research

Comment on Use US Patent

Information Source http://www.freepatentsonline.com/6905736.html

ID 12

PARENT (Common) — **CAS No.** — **EC No.**

PARENT (Not Common) Silicon — **CAS No.** 7440-21-3 — **EC No.** 231-130-8

Type 3D - nanoparticles (nanopowders/fullerenes)

Description Fabrication of Si nanodot transistors using the nc-Si dots solution

Nano-Structured Material (NSM)? No

Nano CAS No. Not listed

Nano EC No. Not listed

Exact Product Code (Example) 26.11.2 Diodes and transistors

Product Category 26 Computer, electronic and optical products

Example Companies-Products

EU Status Research

Comment on Use University Research (Japan)

Information Source http://eprints.ecs.soton.ac.uk/16321/1/cpaper_092.pdf

Examples of Nanomaterials in Products in the EU

ID 1

PARENT (Common) Silica — **CAS No.** 7631-86-9 — **EC No.** 231-545-4

PARENT (Not Common) — **CAS No.** — **EC No.**

Type 1D - nanoplates (nanoscale films/coatings)

Nano-Structured Material (NSM)? No

Nano CAS No. Not listed

Nano EC No. Not listed

Description
Use of silica film on optics as anti-reflective treatment

Exact Product Code (Example)
26.70 Optical instruments and photographic equipment

Product Category
26 Computer, electronic and optical products

Example Companies-Products
ISTN

EU Status Current

Comment on Use Various products are widely used

Information Source
http://istninc.com/ar_glass.pdf

ID 19

PARENT (Common) Zinc Oxide — **CAS No.** 1314-13-2 — **EC No.** 215-222-5

PARENT (Not Common) — **CAS No.** — **EC No.**

Type 2DS - solid nanofibes (nanorods)

Nano-Structured Material (NSM)? No

Nano CAS No. Not listed

Nano EC No. Not listed

Description
Use of zinc oxide nanorods to produce nano-piezotronic™ electronic components such as diodes

Exact Product Code (Example)
26.11.22 Semiconductor devices; light-emitting diodes; mounted piezo-electric crystals; parts thereof

Product Category
26 Computer, electronic and optical products

Example Companies-Products

EU Status Research

Comment on Use University research (US & China)

Information Source
http://nanotechnologytoday.blogspot.com/2007/03/new-class-of-electronic-components-nano.html

Examples of Nanomaterials in Products in the EU

ID 18

PARENT (Common) — **CAS No.** — **EC No.**

PARENT (Not Common) Lithium — **CAS No.** 7439-93-2 — **EC No.** 231-102-5

Type 3D - nanoparticles (nanopowders/fullerenes)

Nano-Structured Material (NSM)? Not determined

Nano CAS No. Not listed

Nano EC No. Not listed

Description
Use of nanosized lithium particles to produce lithion-ion batteries with enhanced properties

Exact Product Code (Example)
27.20.23 Nickel-cadmium, nickel metal hydride, lithium-ion, lithium polymer, nickel-iron and other electric accumulators

Product Category
27 Electrical equipment

Example Companies-Products

EU Status Current

Comment on Use Article identified considers expected growth in market

Information Source
http://www.electronics.ca/publications/products/Nano%252denabled-Batteries-for-Portable-and-Rechargeable-Applications-Types,-Applications,-New-Developments,-Industry-Structure-and-Global-Markets.html

ID 25

PARENT (Common) Silver — **CAS No.** 7440-22-4 — **EC No.** 231-131-3

PARENT (Not Common) — **CAS No.** — **EC No.**

Type 2DH - hollow nanofibres (nanotubes)

Nano-Structured Material (NSM)? No

Nano CAS No. Not listed

Nano EC No. Not listed

Description
Use of silver nanocylinders as waveguides for nano-focusing of light

Exact Product Code (Example)
27.31.1 Fibre optic cables

Product Category
27 Electrical equipment

Example Companies-Products

EU Status Research

Comment on Use University research (China)

Information Source
http://www.iop.org/EJ/abstract/0256-307X/25/9/054

Examples of Nanomaterials in Products in the EU

ID 20

PARENT (Common) Zinc Oxide — **CAS No.** 1314-13-2 — **EC No.** 215-222-5

PARENT (Not Common) — **CAS No.** — **EC No.**

Type 2DS - solid nanofibes (nanorods)

Description Use of zinc oxide nanofibres on a gallium arsenide, sapphire or flexible polymer substrate to create energy generator

Nano-Structured Material (NSM)? No

Nano CAS No. Not listed

Nano EC No. Not listed

Exact Product Code (Example)

Product Category 27 Electrical equipment

Example Companies-Products

EU Status Research

Comment on Use University research (US)

Information Source http://www.gatech.edu/newsroom/release.html?id=1326

ID 27

PARENT (Common) — **CAS No.** — **EC No.**

PARENT (Not Common) Polystyrene — **CAS No.** 9003-53-6 — **EC No.** 202-851-5

Type 3D - nanoparticles (nanopowders/fullerenes)

Description Use of polystyrene nano-spheres as masks during proudction of nano-scale appertures in metal films

Nano-Structured Material (NSM)? No

Nano CAS No. Not listed

Nano EC No. Not listed

Exact Product Code (Example)

Product Category 28 Machinery and equipment n.e.c.

Example Companies-Products

EU Status Research

Comment on Use University research (Sweden)

Information Source http://www.iop.org/EJ/abstract/0957-4484/14/6/321

Examples of Nanomaterials in Products in the EU

ID 24

PARENT (Common) — **CAS No.** — **EC No.**

PARENT (Not Common) Molybdenum — **CAS No.** 7439-98-7 — **EC No.** 231-107-2

Type 1D - nanoplates (nanoscale films/coatings)

Description Mo nano-mask fabricated by AFM lithography as a resist of lift-off process

Nano-Structured Material (NSM)? No

Nano CAS No. Not listed

Nano EC No. Not listed

Exact Product Code (Example)

Product Category 28 Machinery and equipment n.e.c.

Example Companies-Products

EU Status Research

Comment on Use University research (Japan)

Information Source http://www.woe13.lamia.infm.it/Files/PosterSession1/SuzukiPI05.pdf

ID 23

PARENT (Common) Carbon — **CAS No.** 7440-44-0 — **EC No.** 231-153-3

PARENT (Not Common) — **CAS No.** — **EC No.**

Type 1D - nanoplates (nanoscale films/coatings)

Description Generation of diamond coated dies with enhanced performance & durability

Nano-Structured Material (NSM)? No

Nano CAS No. Not listed

Nano EC No. Not listed

Exact Product Code (Example)

Product Category 28 Machinery and equipment n.e.c.

Example Companies-Products

EU Status Research

Comment on Use University research (China)

Information Source http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6TWV-4TWCGDP-2&_user=10&_rdoc=1&_fmt=&_orig=search&_sort=d&view=c&_acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=1758978cf29065d29fabebfa2e0d13c3

Examples of Nanomaterials in Products in the EU

ID 35

PARENT (Common)

CAS No. **EC No.**

PARENT (Not Common) Aluminium — **CAS No.** 7429-90-5 **EC No.** 231-072-3

Type 3D - nanoparticles (nanopowders/fullerenes)

Nano-Structured Material (NSM)? Yes (probably)

Nano CAS No. Not listed

Nano EC No. Not listed

Description

Processing of Al-Ni-Fe alloy to produce nanosized Al particles in matrix with improved characteristics for use in, e.g. value train components and compressor wheels.

Exact Product Code (Example)

Product Category

29 Motor vehicles, trailers and semi-trailers

Example Companies-Products

EU Status Current

Comment on Use Used by vehicle manufacturers

Information Source

http://www.iop.org/EJ/article/1742-6596/144/1/012006/jpconf9_144_012006.pdf?request-id=8e45861a-3908-4f4f-ac9e-800ca81d23f1

ID 30

PARENT (Common)

CAS No. **EC No.**

PARENT (Not Common) Silicon — **CAS No.** 7440-21-3 **EC No.** 231-130-8

Type 2DH - hollow nanofibres (nanotubes)

Nano-Structured Material (NSM)? No

Nano CAS No. Not listed

Nano EC No. Not listed

Description

Development of nanotubes as hydrogen storage mechanism for use in hydrogen powered vehicles

Exact Product Code (Example)

Product Category

29 Motor vehicles, trailers and semi-trailers

Example Companies-Products

EU Status Research

Comment on Use University research (China)

Information Source

http://www.greencarcongress.com/2008/04/silicon-nanotub.html

Examples of Nanomaterials in Products in the EU

ID 36

PARENT (Common) Carbon — **CAS No.** 7440-44-0 **EC No.** 231-153-3

PARENT (Not Common)

CAS No. **EC No.**

Type 1D - nanoplates (nanoscale films/coatings)

Nano-Structured Material (NSM)? Not determined

Nano CAS No. Not listed

Nano EC No. Not listed

Description

Nano-graphene platelets (NGPs) for automotive uses - fuel systems, tyres, polymer composites, etc

Exact Product Code (Example)

Product Category

29 Motor vehicles, trailers and semi-trailers

Example Companies-Products

Angstron Materials LLC

EU Status Current

Comment on Use Produced by US Company for automotive & other purposes

Information Source

http://www.angstronmaterials.com/marketapplications.htm

ID 33

PARENT (Common) Carbon — **CAS No.** 7440-44-0 **EC No.** 231-153-3

PARENT (Not Common)

CAS No. **EC No.**

Type 2DS - solid nanofibes (nanorods)

Nano-Structured Material (NSM)? Yes

Nano CAS No. Not listed

Nano EC No. Not listed

Description

Carbon fiber reinforced-ceramic matrix composite used in brake disc

Exact Product Code (Example)

Product Category

29 Motor vehicles, trailers and semi-trailers

Example Companies-Products

e.g. Aston Martin

EU Status Current

Comment on Use Used by some European vehicle manufacturers

Information Source

http://www.sicom-brakes.de/DMC_-_Prasentation1.pdf

Examples of Nanomaterials in Products in the EU

ID 28

PARENT (Common) Carbon — **CAS No.** 7440-44-0 — **EC No.** 231-153-3

PARENT (Not Common) — **CAS No.** — **EC No.**

Type 2DS - solid nanofibes (nanorods)

Nano-Structured Material (NSM)? Yes (probably)

Nano CAS No. Not listed

Nano EC No. Not listed

Description
Use of carbon fibres at strategic points in trailer decks to allow thinner construction

Product Category
29 Motor vehicles, trailers and semi-trailers

Exact Product Code (Example)
29.20.30 Parts of trailers, semi-trailers and other vehicles, not mechanically propelled

EU Status Current

Comment on Use German vehicle manufacturer producing model

Example Companies-Products
Kögel Fahreugwerke GmbH of Burtenbach, Germany.

Information Source
http://trailer-bodybuilders.com/chassis/world_views_new_vehicles_iaa_0209/

ID 32

PARENT (Common) Carbon — **CAS No.** 7440-44-0 — **EC No.** 231-153-3

PARENT (Not Common) — **CAS No.** — **EC No.**

Type 2DS - solid nanofibes (nanorods)

Nano-Structured Material (NSM)? No

Nano CAS No. Not listed

Nano EC No. Not listed

Description
Planned mass production of carbon fiber automotive parts

Product Category
29 Motor vehicles, trailers and semi-trailers

Exact Product Code (Example)

EU Status Near market

Comment on Use Japanese companies

Example Companies-Products
Teijin Ltd. ; Mitsubishi Chemical Corp.

Information Source
http://www.greencarcongress.com/2008/03/teijin-mitsubis.html

Examples of Nanomaterials in Products in the EU

ID 31

PARENT (Common) Carbon — **CAS No.** 7440-44-0 — **EC No.** 231-153-3

PARENT (Not Common) — **CAS No.** — **EC No.**

Type 2DH - hollow nanofibres (nanotubes)

Nano-Structured Material (NSM)? No

Nano CAS No. Not listed

Nano EC No. Not listed

Description
Development of nanotubes as hydrogen storage mechanism for use in hydrogen powered vehicles

Product Category
29 Motor vehicles, trailers and semi-trailers

Exact Product Code (Example)

EU Status Research

Comment on Use University research (China)

Example Companies-Products

Information Source
http://www.greencarcongress.com/2008/04/silicon-nanotub.html

ID 34

PARENT (Common) Silica — **CAS No.** 7631-86-9 — **EC No.** 231-545-4

PARENT (Not Common) — **CAS No.** — **EC No.**

Type 3D - nanoparticles (nanopowders/fullerenes)

Nano-Structured Material (NSM)? Yes

Nano CAS No. Not listed

Nano EC No. Not listed

Description
Use of nanoclay in thermoplastic body parts for vehicles

Product Category
29 Motor vehicles, trailers and semi-trailers

Exact Product Code (Example)
29.20.1 Bodies for motor vehicles

EU Status Current

Comment on Use Used by vehicle manufacturers

Example Companies-Products
e.g. General Motors

Information Source
http://www.compositesworld.com/articles/nanoparticles-nanotubes-and-nanocomposites.aspx

Examples of Nanomaterials in Products in the EU

ID 39

PARENT (Common)

CAS No.
EC No.

PARENT (Not Common) Nickel

CAS No. 7440-02-0
EC No. 231-111-4

Type 1D - nanoplates (nanoscale films/coatings)

Nano-Structured Material (NSM)? No (probably)

Nano CAS No. Not listed

Nano EC No. Not listed

Description
Nickel foil with 20nm average grain size giving high strength, high resilience, excellent corrosion resistance.

Exact Product Code (Example)

Product Category
30 Other transport equipment

Example Companies-Products
Integran Defense systems

EU Status Current

Comment on Use Produced by US Company for defense and aeroscape

Information Source
http://www.integrandefense.com

ID 40

PARENT (Common) Carbon

CAS No. 7440-44-0
EC No. 231-153-3

PARENT (Not Common)

CAS No.
EC No.

Type 1D - nanoplates (nanoscale films/coatings)

Nano-Structured Material (NSM)? No

Nano CAS No. Not listed

Nano EC No. Not listed

Description
Nano-graphene platelets (NGPs) for aircraft braking systems, thermal management, EMI/RFI shielding, and lightning strike protection

Exact Product Code (Example)

Product Category
30 Other transport equipment

Example Companies-Products
Angstron Materials LLC

EU Status Current

Comment on Use Produced by US Company for aeroscape and other purposes

Information Source
http://www.angstronmaterials.com/marketapplications.htm

Examples of Nanomaterials in Products in the EU

ID 37

PARENT (Common) Carbon

CAS No. 7440-44-0
EC No. 231-153-3

PARENT (Not Common)

CAS No.
EC No.

Type 2DH - hollow nanofibres (nanotubes)

Nano-Structured Material (NSM)? Yes

Nano CAS No. Not listed

Nano EC No. Not listed

Description
C-nanotubes used in composite in bicycles for strength & weight saving

Exact Product Code (Example)
30.92.10 Bicycles and other cycles, not motorised

Product Category
30 Other transport equipment

Example Companies-Products
BMC, Easton Sports, Inc. & Zyvex Corporation

EU Status Current

Comment on Use Produced by US & European Companies

Information Source
http://www.zyvex.com/News/Easton_PR.html; http://www.netcomposites.com/news.asp?3123

ID 15

PARENT (Common) Silica

CAS No. 7631-86-9
EC No. 231-545-4

PARENT (Not Common)

CAS No.
EC No.

Type 3D - nanoparticles (nanopowders/fullerenes)

Nano-Structured Material (NSM)? Yes

Nano CAS No. Not listed

Nano EC No. Not listed

Description
Use of nanoclay in composite hull material to give improved strength and reduce weight

Exact Product Code (Example)
30.1 Ships and boats

Product Category
30 Other transport equipment

Example Companies-Products
Yamaha

EU Status Current

Comment on Use Used by Japanese boat builder

Information Source
http://www.jeccomposites.com/press-releases/4436/2008-JEC-Innovation.html

Examples of Nanomaterials in Products in the EU

ID 21

PARENT (Common) Carbon — **CAS No.** 7440-44-0 — **EC No.** 231-153-3

PARENT (Not Common) — **CAS No.** — **EC No.**

Type 2DS - solid nanofibes (nanorods)

Nano-Structured Material (NSM)? Possibly

Nano CAS No. Not listed

Nano EC No. Not listed

Description
Incorporation of carbon nanofibres in upholstery foam to aid fire resistence

Exact Product Code (Example)

Product Category
31 - Furniture

Example Companies-Products

EU Status Research

Comment on Use US National Fire Protection Association

Information Source
http://www.physorg.com/news148142548.html

ID 47

PARENT (Common) Silver — **CAS No.** 7440-22-4 — **EC No.** 231-131-3

PARENT (Not Common) — **CAS No.** — **EC No.**

Type 1D - nanoplates (nanoscale films/coatings)

Nano-Structured Material (NSM)? No

Nano CAS No. Not listed

Nano EC No. Not listed

Description
Nanosilver used as an antic-microbial agent in protective coatings on medical products (implants, dressings, etc.)

Exact Product Code (Example)
32.50 Medical and dental instruments and supplies

Product Category
32 Other manufactured goods

Example Companies-Products
Bio-gate (Germany)

EU Status Current

Comment on Use Products available on EU market

Information Source
http://www.bio-gate.de/page.asp?lang=e&main=0&did=503&sec=1&third=1

Examples of Nanomaterials in Products in the EU

ID 38

PARENT (Common) Titanium Dioxide — **CAS No.** 13463-67-7 — **EC No.** 236-675-5

PARENT (Not Common) — **CAS No.** — **EC No.**

Type 3D - nanoparticles (nanopowders/fullerenes)

Nano-Structured Material (NSM)? No

Nano CAS No. Not listed

Nano EC No. Not listed

Description
Titanium dioxide particles applied as film coating to range of building materials to endow "self cleaning" properties to wood, brick & glass

Exact Product Code (Example)

Product Category
32 Other manufactured goods

Example Companies-Products
BioShield Inc.

EU Status Current

Comment on Use Produced by US Company

Information Source
http://titaniumdioxide.219445.free-press-release.com/